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EDMUND RUFFIN, EDITOR AND PROPRIETOR.

JOHNSTONE'S 'TREATISE ON DRAINING,' &c.

(Continued from page 526, No. 9.)

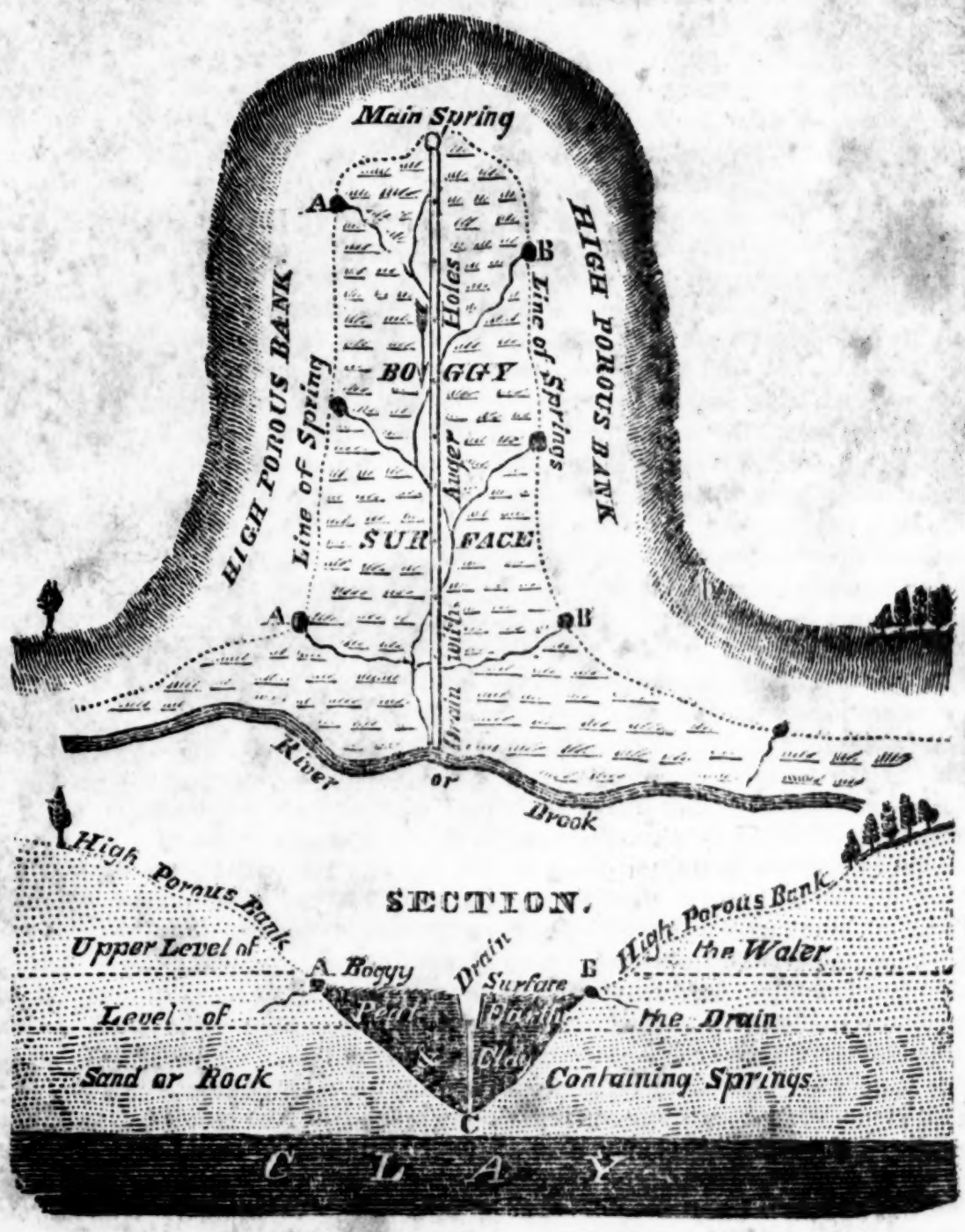
The common practice of draining ground in this situation, according to the old method, has been described in the 4th section of Part I, where it is shown, that in most cases the drains were drawn parallel to one another, *from the outlets to the spring heads*; but another method, followed by drainers who were reckoned more expert, was to draw a number of lines parallel to one another, *across* the declivity; a practice equally expensive, but in some degree more rational, and therefore more effective than the other. The consequence of this, however, is only to render the ground drier while the drains continue to run; but these, not being of sufficient depth, and filled with loose stones to the top, soon choke up, and the ground becomes as wet, or more so, than before. They have then the bad effect of altering the surface so much from its original appearance, that the true situation of the springs cannot afterwards be so easily discovered, and the frequent bursts, which in time, assume the appearance of springs, serve to increase the perplexity.

Besides those of the nature, and in the situation now described, there are a variety of other spring bogs, though of less extent, and diversified in their appearance, to which the same principle applies, and these require next to be explained. Bogs, and other wet ground, may be formed, in similar situations, from a variety of the same causes, and, consequently, require different treatment—bogs, for example, in a valley betwixt two hills, or where the ground rises from both sides.

In examing these, the first thing is to consider, whether the springs proceed from one side only, from both sides, or lie in the middle, which may be ascertained with a spirit level, and by exploratory boring.

If the bog has a descent from the side A A, to the side B B (see plate No. X.) although wetness appear round all the sides, it is clear that the water proceeds only from the higher side A A,

PLATE X.—*Draining of Spring Bogs.*



Plan.—AA, BB Springs. *Section*—A B Springs; C Auger-hole.

and passing through and under the surface, part of it is absorbed by the dry ground, along the side B B; from whence, if the level was not previously ascertained, it might be supposed also to proceed. In this case one drain, cut along the upper side A A, will be sufficient to keep it dry; but if there is a descent from both sides to the middle, or the ground be perfectly level, it will require a drain on both; and, if the substrata in which the water lies, is connected with the higher ground on both sides, and unites below, one drain in the middle, cut to the depth of that strata, or bored down to it, will be sufficient, as represented in the plan and section No. X. Where the expanse of the valley, or distance betwixt hills or high ground along the sides is narrow, this will certainly be the case. But, if a bog of this nature, between two hills, is of great extent, it may be requisite to have three different drains, one on each side, and one in the middle; the last should be an open drain, to receive all the surface water, as well as to cut off any springs that may rise in that part of the bog. In this, as in all other cases, where there is any difficulty of ascertaining the substrata, and from whence the springs proceed, the auger may be *previously* applied.

In very extensive bogs or swamps, it is necessary to have other cuts, than those which carry off the principal springs; for, although these may be effectually cut off, there may be inferior veins* of sand and gravel, out of which, it is also necessary to extract the water. If the ground is to be divided into separate inclosures, the open ditches may be so directed, as to hit on these lesser collections of subjacent water, and, at the same time, to carry off any that might stagnate in the hollow parts of the surface. It frequently occurs, where a hill or rising ground has wetness on both sides, apparently on the same level, that a drain properly conducted on the one side, may remove the wetness from the other. If the resisting stratum lies horizontally through the hill or bank, the surface below that, will be wet and rushy on both sides, the upper line of which, will be found varying very little from a level all the way round; and here, a drain, on either side, giving a lower and readier vent to the water than its natural outlets, may make both sides dry. If the resisting stratum *dips*, or inclines more to the one side than to the other, the springs will issue only at the lower side, where that stratum terminates; consequently, the one side of the hill will be wet, and the other dry. The rushes, alders, and other aquatics, facilitate investigations of this kind; for they never appear above the line of the springs, except in cases, where the water flows back for want of outlet, when the springs are very full; but in cases where more minute observation is requisite, such appearances cannot altogether be depended on.

In many cases, it may be known whether the channel of the water, from which the springs are supplied, lies deep, or not, by their appearance on the surface. If the land be dry, immediately above the place where the water springs up, it is a sign that the channel or reservoir lies deep, and that the water is issuing perpendicularly; but, on the contrary, if the land be wet for some distance above the principal outlet of the spring, it is a sure indication that the water is flowing in a channel near the surface, and that it is the overflowing of it which causes this higher wetness. It would be a certain evidence of this, if there be only one spring in the wet ground; but, if the internal strata do not lie horizontally, or regular, and several springs appear, arising from different channels, the land above the largest, or principal spring, may be wet, not from the flowing back of that spring, or its channel being near the surface, but by the breaking out of lesser springs, in their descent, finding a vent to the surface, higher than that of the larger spring. It is in cases of this kind, where draining is attended with most difficulty; and where all the cutting, &c. necessary, cannot be easily ascertained at first, till what is absolutely requisite be executed, which will lead to a discovery of what more may be requisite, and in what manner it can best be done, by exposing to view, the subsoil or strata in which the water flows. Making exploratory bores with the auger, is useful in this, and in all other doubtful or difficult cases.

In irregular wet banks, where the ground, owing to its perpendicular situation, and pressure of water behind, has slipt or fallen down, the drain should be carried higher up the declivity, than where the water has its apparent outlet. The proper line for it, therefore, is, in the sound unbroken ground that has undergone no change, and where the *real* spring will be intercepted; the water in the slipt or shifted sand below, being only a *leakage* from the spring above, which, from its appearance, is apt to be mistaken for the spring itself, and thereby mislead in directing the drain.

Where the principal spring comes out of a very steep bank, at a considerable height above the level of the outlet where the water is to be discharged, it is unnecessary to cut a deep trench, or lay a covered drain, all the way from such outlet, up to it; for the descent being rapid, and the cut deep, by crossing veins of sand, and other loose substances, always met with in such situations, the stones or materials with which the drain may be laid, would be undermined by the quickness of the current, and might be choked by the quantity of running sand, which the water carries along with it.

It is only necessary, in such cases, to begin as far down the bank, as, by cutting forward upon a level, the drain may be six feet deep, when it comes to the spring, or whatever depth is necessary, for the cross-drain that is to be cut along that line. The remaining part of the cut, which is merely a conductor for the water, either in a straight or sloping direction, may be either open, or covered, as circumstances require; but there is no necessity for its being so deep as the upper drain, nor is there occasion for boring in any part of it. It should be guarded from the treading and poaching of cattle when the ground is in pasture, and from injury by the plough when in tillage. See figures 1 and 2, plate No. XI. Where there is any difficulty in ascertaining the true line of the spring, and consequently that of the cross-drain, either from its not showing itself on the surface, or having no apparent outlet from whence to trace the level, this line may be discovered, in bringing up the conducting drain, in which, as soon as the water begins to rise freely, from that point is the proper place to branch off the cross-drain, and upon that level, to carry it as far as the wetness

*Very thin, or narrow strata.

PLATE XI.—*Draining of Bogs.*

Fig. 3

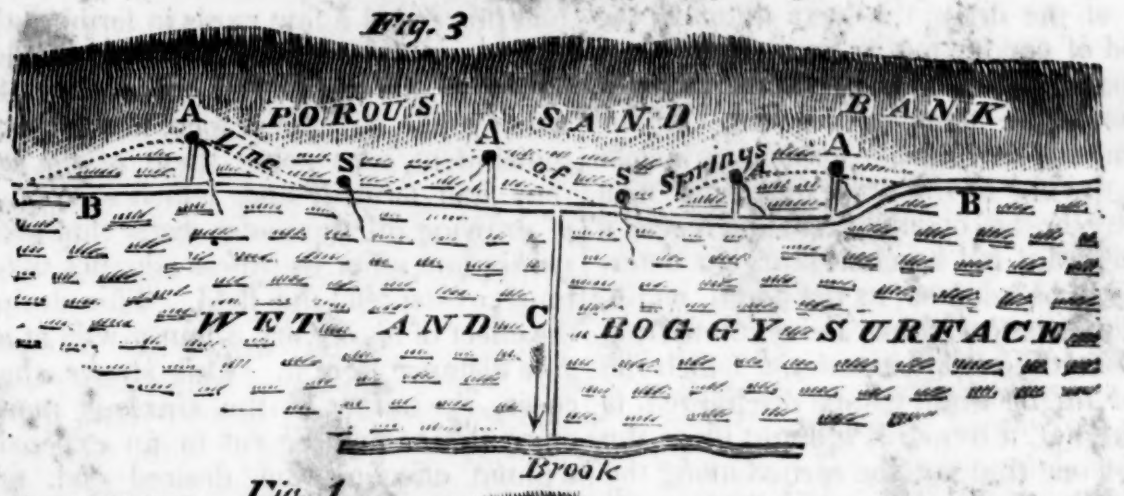


Fig. 1

Fig. 2

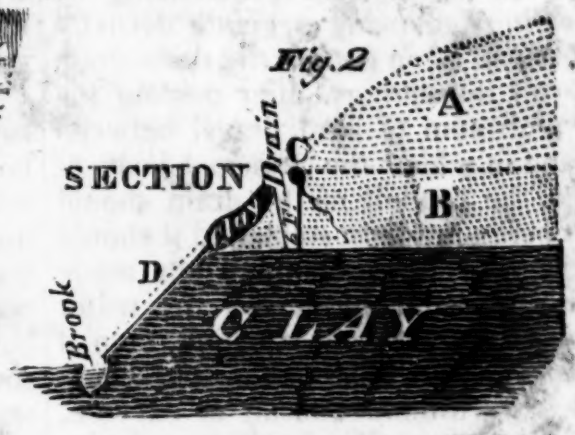
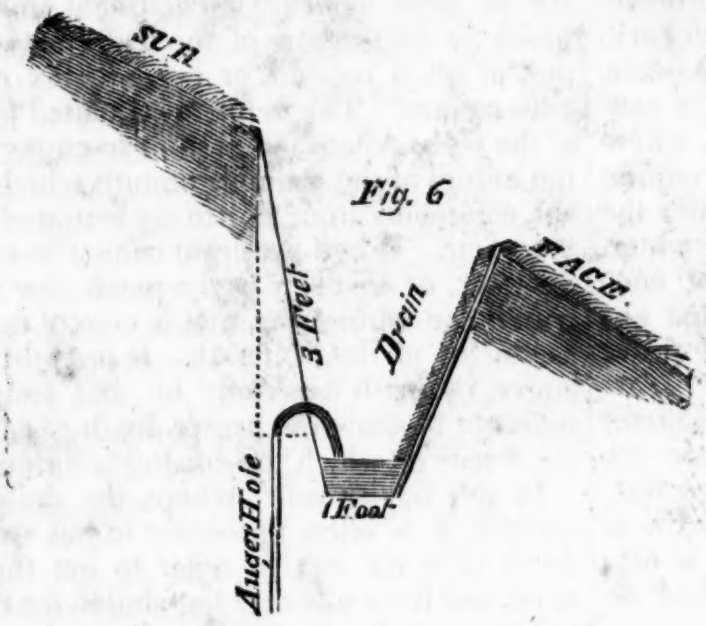


Fig. 5

Fig. 6



ig. 4.

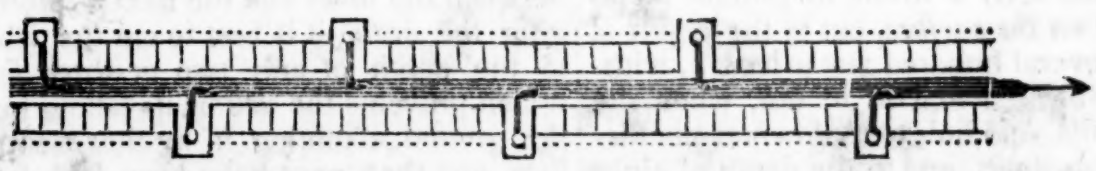


Fig. 1. *Plan.*—A, Covered drain. B, Orifice of covered drain. C, Open cuts.
Fig. 2.—*Section.* A, Porous earth. B, Sand, containing the springs. C, C Outlet of the spring. D Open cut.
Fig. 3.—B B Drain covered on a level—but in some places below the springs.
Fig. 5.—A The sough or conduit 6 in. square. B A few small stones above the cover. C Turf inverted
Fig. 6.—Section representing boring in an open drain.

extends. If, in digging the cross-drain, in the line laid out by the spirit level, for the purpose of cutting off the water and leading it to the discharging drain, it should be found, in some places, *below* that of the springs, and where, by boring, no water is brought up, it will be necessary to make short cuts of the same depth, from the cross-drain, up to the source of the springs, (as at the letters A in figure 3 of plate No. XI.); for if the drain be cut too far *below the line* of the spring, all possibility of reaching it, even with the auger, is lost; and if it be *above the line* of the spring, it will be requisite to cut, and bore much deeper, in order to reach it, the ground being in general higher in that part. Besides, the portion of porous subsoil, below the drain, may contain a quantity of water sufficient to render the ground wet, and which may pass *under* the bottom of the trench, between the auger-holes, and break out lower down on the declivity.

Such being a description of the general appearances that are met with, and to be studied, in conducting the drainage of spring bogs, in their various situations, and also the rules for finding

the main-springs, tracing their level, and guiding the direction of the drain, the next thing is, the proper method of conducting its execution.

The first point then is, to determine whether the drain should be open or covered. If the ground is open, and it would be proper to inclose it, and where the line of the drain may serve as a division, it may be an open cut, or sunk fence; if not, a covered drain; but it is necessary to determine which is to be adopted, as the depth, width, and other circumstances, must be regulated accordingly. When the nearest outlet at which the water collected in the drain can be discharged, is fixed on, from that, a trench is brought up to the line of the cross one that is to be carried along the course of the springs, allowing a gentle declivity for the water to run. If, in cutting the cross-drain that is to carry off the springs, after passing the clay, there be a stratum of hard gravel between that and the sand in which the principal body of water is lodged, the conduit of the drain should be laid on it, as being the most solid; and it should be perforated by the punch, or small pits made through it with the spade, whereby the water may flow up, and run with more safety, than if the drain were laid in the sand bed below, which would not only make it more difficult to execute, but may sometimes be at such a depth, that the level of the outlet will not allow the drain to be cut to it.

In all other cases, except those of quicksands, where it is very difficult to lay and secure the conduit of the drain, the most certain method, where the level will admit, and where it does not require an extraordinary depth of cutting, is to carry the drain down to the stratum containing the water, and lay the conduit there. But where that cannot be obtained at a reasonable depth and expense, the auger must be applied, and the water brought up by that means.

When the drain is only to act as a conductor for the water brought up by *boring*, where the soil is *all clay*, its depth need not exceed four feet, which will be sufficient to allow a proper depth of earth above the stones forming the conduit at bottom, which need not exceed, nor ever should be less than one and a half or two feet.

The author has seen a drain, in ground apparently very wet *on the surface*, cut to the depth of four feet, and several hundred feet in length, without any water being found in it; but, when the auger was applied, and holes put down at the distance of six yards apart, and to the depth of eight or ten feet, a considerable stream of water was brought up, and which afterwards continued to flow. In one instance,* he directed a drain to be cut in a very close and retentive clay soil, which at the depth of four feet found no water. This gave occasion for the workmen to say, and the proprietor to think, that this *drain* would affect his *pocket* more than the *field;* but they were soon sensible of the injustice of such a remark. As the drain had a smooth and uniform slope in the bottom, in order to expedite the work, several men were employed in laying the stones for the conduit, beginning at the lower end and proceeding upwards, while others were engaged in boring at the upper end, and were to proceed downwards. When those below began their work, the drain was quite dry, and no appearance of water from either sides or bottom; but by the time they had proceeded a few yards in forming the conduit, and two or three holes had been made with the auger, at the upper end, an unexpected *rush* of water made its appearance, to their no small astonishment, convincing them of the *rash* opinion they had formed; and which soon had the *effect* of drawing off the *under-water* that produced the *rushes* and other worthless aquatics, which had so much overspread the field. This drain had also the effect of laying dry a pump-well at a considerable distance from it. This shows, that in such cases, the auger is the *sine qua non*, and that many drains may be cut to an expensive depth, without effecting the desired end, or without making any material change on the appearance of the ground.

If the drain is to be cut through a soft boggy soil, it is better to be open than covered, particularly if it be in a situation where it may receive other water than that collected from below, and may serve as a division betwixt the upland and low grounds; for stones are apt to sink, and give way, in such soft bottoms, and so the drain is liable to be filled up and destroyed. The width of a covered drain is from three to four feet at top, and one and a half or two feet at bottom, thus giving six or nine inches for each side stone, and as much for the passage of the water between; forming, in all, a conduit, or opening, six or nine inches square. The depth is regulated by the level of the place where the drain is to empty itself, and the nature of the ground through which it is to be cut, commonly from four to six feet, and never less than four. When the drain cannot be cut through the clay, or so deep as to reach the stratum in which the spring lies, and is merely to act as the conductor of the water that is brought up by the auger, its depth need only be four feet; which is sufficient to allow the proper depth of earth, above the stones of which the conduit is formed.

In soft boggy soils, where the drain is to be covered, it is often necessary to cut to a greater depth than six feet. in order to get through the moss, and have a secure foundation for the stones, and as a great part of the water is always lodged between the moss and the next stratum. In digging the drain, it is best to cut the whole length, to the depth of only two or three feet at first, which prevents the risk of its falling in; and when the ground adjoining it, by that means, becomes firm, and the stones have been laid down by the sides of it, then it may be cut to the full depth required. In opening the drain, it should be begun at the lower end, and carried upwards, laying the turf along the upper, and throwing out all the stuff to the lower side. In laying the drain, it should be begun at the upper end, and proceeded with downwards, smoothing and clearing the bottom before laying the stones. By this means the fall is seen, and can be kept; for, when begun at the lower end, and laid upwards in level ground, there is danger of digging too deep, in clearing the bottom; by which means, a stagnation of water and sludge takes place, which ought always to be avoided.

The most difficult part of the work is, laying the conduit in running sands, where it is necessary to have the sides of the trench supported with flat boards and props, which are removed forwards as they proceed in working. This gives security to

* At Drum, in Aberdeenshire.

the sides, and prevents the loose sand and other matter from falling among the stones, while the conduit is being formed. The turf is laid grass-side downwards above the stones, and it is seldom necessary to have any (or at least very few) loose stones above the conduit, except where the stratum, in which the water flows, is so thick that the height of the conduit does not reach the upper part of it; then it is requisite to have the stones so high, that the water may percolate through them to the conduit below. In quick or running sands, it is also necessary sometimes to put thin stones, slates, or thin turfs in the bottom of the drain, to prevent the loose sand from flowing up, and the stones from sinking. Before boring, it is proper to lay the side stones of the conduit; after which, the holes may be made at the distance of every three or four yards; but if the water, on withdrawing the auger, rush up with violence, it indicates a strong body of it below, and therefore requires a greater number of openings, (by boring), to give it a speedy and sufficient outlet. When the force of the water is great, the width of the holes enlarges, and consequently the discharge increases.

By a careful examination of the adjoining grounds, and attention to the strata of which they are composed, it is sometimes possible to say at what depth the spring lies, and how deep the boring should be; but the rule is, to go down till the water rise freely on withdrawing the auger. Mr. Elkington bored a hole thirty feet deep, near Tamworth in Staffordshire, through which water issued at the rate of *three hogsheads a minute*, and laid dry a great extent of wet ground in the neighborhood; and in a drain, which the author directed to be cut at Upleatham, in Yorkshire, the seat of Lord Dundas, an astonishing quantity of water was brought up, by boring to the depth of twenty-four feet below the bottom of the drain. These instances are mentioned to show, that the water sometimes lies at a considerable depth, and that when brought up by the auger, notwithstanding the extraordinary depth, it has the desired effect. Deep boring, therefore, should not be a discouragement, when the object to be gained requires it. It is better to put down the auger holes a little to a side, and not in the middle of the drain, as the water that comes from them is, by that means, less apt to be interrupted by the current passing along the centre of the drain. The figures 4 and 5, in plate No. XI. represent this.

That part of the conduit, above the auger holes, should be left uncovered, till the sand, which is at first apt to rise so abundantly with the water, subsides, and the openings become clear; and then they may be covered with safety. When the holes made by boring are not sufficient for discharging and letting off the quantity of water which the spring would emit, and when the stratum containing the water is near to the bottom of the trench, and the intervening one difficult to penetrate with the boring instrument, pits may be made with the spade, and filled with small loose stones, which will give a wider outlet and quicker vent to the spring. There need be no apprehension of the holes made by the auger or spade filling up, whether the drain be open or covered, provided no other water is admitted; for such is often the force of the spring, that it will throw up any earth or sludge that may accidentally get into it, and can only be injured by a great quantity of surface or flood water coming upon it at once.

Where stones can be got, they are preferable to brick; but there are several kinds of brick invented and used solely for the purpose of draining, in different parts of England; but principally the common kind has hitherto been made use of in Scotland. In forming the conduit of brick, a small aperture, (of above an inch), should be left between each, to admit the water that comes from the sides of the drain. In very wet and spongy soils, during the time the drain is cutting, the water from the surface, and what may trickle from the sides of the trench, should be stopped occasionally; and when let off to pass through the conduit, (if part of that has been previously formed), a turf should be placed at the entrance of it, so as to prevent any soft earthy matter from passing along with the water, that might choke or injure the laid part of the drain. Where the roots of trees interfere in the course of the drain, they should be completely grubbed up; for if this is not done, the fibres of the roots extend themselves through the joints and openings of the stones, and soon put a stop to the passage of the water. Though the earth that has been dug out of the drain appears, when filled in again, considerably higher than the surface of the ground at the sides, it should remain so; for, in a short time, it sinks to the common level; but if made so at first, the earth would subside, and leave a hollow over the drain, in which surface-water might lodge, and, finding its way downwards, might injure the conduit below, by carrying part of the earth along with it. Lastly, the mouth of the drain should be carefully guarded, by railing it in, or otherwise protecting it from being poached, and filled up by the treading of cattle, in their attempts to drink at it; and when any injury of this kind happens, it should always be immediately removed. For this purpose, it is necessary frequently to examine the outlet of all drains, and to remedy any defect that may happen. The first symptoms of the drains proving effectual, and which soon become obvious when the springs have been completely drawn off, are, that all surface-drains that may have formerly been made, pits, ditches, and other hollow places in which the water may have stood, suddenly become dry, and remain afterwards in that state.

In consequence of drains that have been made according to this system, wells have become dry; and springs, at a considerable distance, have abandoned their former courses, and their original outlets have been dried up! *By cutting off one spring alone*, by which the particular place to be drained may have no *apparent* connection, but may be so connected *under ground*, that, from *it*, all the others derive their source; and being therefore the *principal cause* of the whole wetness, *to cut it off* is the chief desideratum of the business.

Of this there are many instances in Mr. Elkington's practice, where, by a very short line of drain, with a few auger-holes hitting on the particular places where the *lowest part of the main spring lay*, a considerable extent of ground, with which his drain had seemingly no apparent connection, has been laid dry, to the astonishment of those who have seen it, and furnishing a subject of incredibility to many who have not. At Odstone Hall, in Leicestershire, a very remarkable drainage of this description took place. A considerable tract of wet marshy land, of very lit-

tle value, divided in the middle by a small river, was so completely drained by making a trench* at one side, and *boring* in it, that the part of the marsh on the opposite side of the rivulet, at a very considerable distance from the drain, became, in a short time, equally dry as that where the trench was made; has continued to be so ever since; and, from being formerly of little or no value, is now converted into excellent water-meadow, producing, without manure, abundant crops of grass.

At Madley, near Newcastle in Staffordshire, there was a bog of some hundred acres, the drainage of which was always deemed impracticable, being of so wet and soft a nature that no cattle could pass over any part of it, till Mr. Elkington, having obtained a lease of it for a certain number of years, so effectually drained it, with comparatively very little cutting and expense, that it may now be considered not only as one of the most wonderful undertakings of the kind so easily accomplished, but is also, by the other improvements made on it, now become one of the most productive farms in that part of the country. Many more instances of remarkable drainages of the same kind, executed by Mr. Elkington in different parts of England, founded on the principles already explained, and taken notice of in the Agricultural Reports of the counties in which they took place, will be shown in another part of this treatise.

In corroboration of these *facts*, since the publication of the *first edition* of this *work*, many and successful drainages have been accomplished under the author's direction, in different parts of Scotland. In cases of such similarity, to describe the particulars of each would appear tedious and uninteresting; but above others, that in the extensive and picturesque *Park* of *Dalkeith*, belonging to the Duke of Buccleuch, is worthy of being mentioned particularly. In every part of the operation, the drains were conducted in exact conformity to the true principles of the system, and according to the rules and directions given for the draining of ground injured by the effects of spring water in its various shapes and degrees. Besides making the ground dry, and consequently more sound and productive, the drains there, served another useful purpose, by affording a *constant supply* of *spring water* to different parts of the *park*.

From the explanation that has thus been given, it will appear that this mode of draining bogs, or land injured by subterraneous water, is by far the most scientific and effectual that has hitherto been put in practice.

Of the many proofs of this, in the southern part of the kingdom, where Mr. Elkington's practice chiefly lay, the most remarkable have been detailed in the various county Reports, published by the Board of Agriculture, a few extracts from which are given in Part IV. of this treatise.

In most of the counties, and on many estates in this part of the kingdom, similar successful drainages have been executed; and its decided superiority over the modes formerly practised, is now acknowledged as preferable to every other. On the extensive estates of the Dukes of Buccleuch, Gordon, Montrose; Earls of Strathmore, Mansfield, Aberdeen, Aboyne, Finlater, Fife, Kintore, Wemyss; Lord Dundas, Lord Panmure, Lord Saltoun, Lord Melville, Lord Wharncliffe; Honourable Mr. Halyburton; Sir Robert Burnett, Bart.; Sir Evan Murray Macgregor, Bart.; William Adam, esq. (late Lord Chief Commissioner of Jury Court); General Hay of Rannes; late Mr. Brodie of Arnhall; late George Skene, of Skene, esq. Mr. Ramsay of Barnton, Mr. Mansfield of Midmar, Mr. Ferguson of Pitfour, Mr. Urquhart of Craigston, Mr. Urquhart of Meldrum, Mr. Irvine of Drum, and many others (on a lesser scale), too numerous to mention, particularly in the counties of Aberdeen, Banff, Forfar, Fife, Kincardine, Mid-Lothian, Perth, Roxburgh, and Stirling; where it has been extensively, and, in most cases, very successfully practised.

* *Trench* is the term generally used, in many parts of England, in place of drain; and *sough*, (pronounced *suff*), is the conduit laid at bottom.

SECTION III.

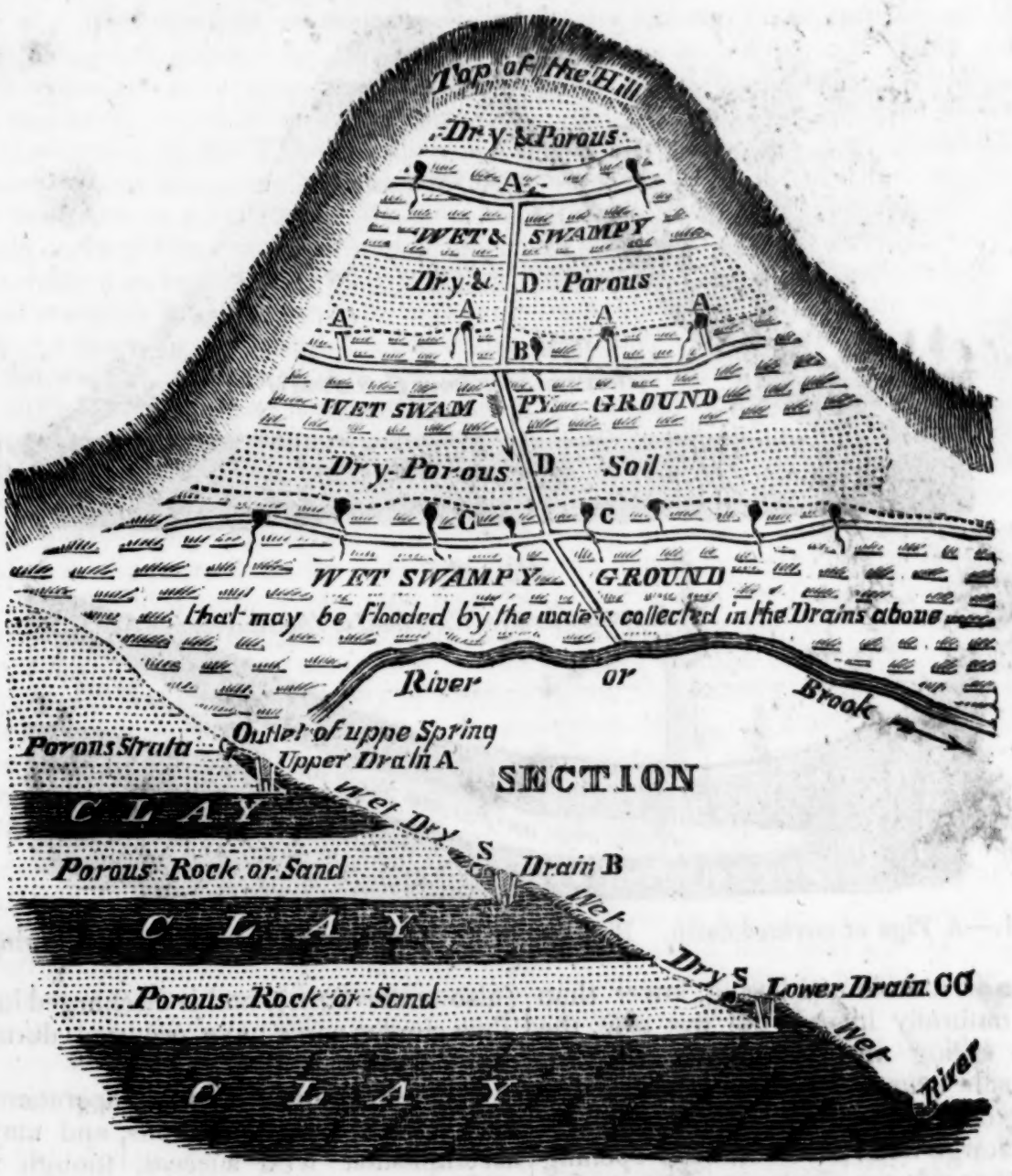
Its application to the drainage of hills, and to the procuring and raising water for wells, &c.—also to low ground lying on the side of rivers, and to other soils injured in a less degree by spring water.

From what has been stated in the foregoing section, less remains to be explained in this, as bogs are certainly more the field of its operation, than any inferior kinds of wet ground, to which this system applies. The sides or declivities of many hills are, owing to the irregular disposition of the component strata, covered with alternate portions of wet and dry ground. By the general appearance of the surface, and the variety of herbage which the different soils produce, according to their dryness or the degrees, of wetness which affect them, the internal strata, and manner in which they are disposed, may often be ascertained, with such degree of certainty, as to guide the direction of the proper drains, applicable to the nature of the wetness, without any internal investigation. The difficulty or facility with which such ground may be drained, depends entirely upon the position of the different strata of which the hill is formed; and upon the perpendicular, horizontal, or slanting inclination of the rock, or other body in which the water is contained, and out of which it issues.

Where the rock lies in a horizontal, or has a slanting inclination, the whole of the different springs or outlets of water that show themselves on the surface, may be connected with, and originate from the same source, and may be all drained or dried up, by cutting off or letting out the main body of water. But where the rock lies in an upright or perpendicular position, and contains only partial collections of water among the more open cracks and fissures of the stone, which empty themselves at numberless outlets unconnected with one another, it would be fruitless to attempt cutting them off by one drain, or by boring into any particular one of them, without cutting a drain into each, as marked at the points A, in plate No. XII.

In this case, it is more advisable to make the main drain so low down as to insure its being in the clay, and to have small cuts up from it to the outlet of each spring, than to carry it along the upper line where the water breaks out; for, in that direction, it would be much upon the rock, and

PLATE XII.—*Drainage of hills, procuring water for wells, &c. &c.*



Plan.—D D Conducting drain. *Section.*—S S Springs.

consequently very difficult to cut, on account of the nature and disposition of the stone. Where the water that issues out along the upper line can, by means of boring, be hit on in the main drain, at the points marked B, it will be effectually drawn off; but if that is not practicable, the depth of the small cuts will reduce it to such a level as will prevent its flowing over and injuring the surface of the land below.

In such hills as are composed of alternate strata of rock, sand, and clay, the surface of the latter is often wet and swampy, while that of the former is dry, and producing good grass. In these cases, as many cuts will be necessary to drain it, as there happen to be divisions of wet and dry soil. The most elevated part of the hill, being composed of porous strata, receives the rain water which descends through it, till obstructed by an impervious bed of clay; it then follows the course of this to the surface, and overflows it as far down the descent as the clay extends.

After this, the water is absorbed by the succeeding porous stratum, and descending through it, in the same way as above, it again issues at the lower side of it, and renders the surface of the next clayey soil as wet as it did that of the first. In this manner the same spring will affect the other similar strata, of which the hill is composed, down the whole declivity, and form at last, in the hollow at the bottom, a bog or a lake, if there is no natural outlet or descent for the water.

In order, then, to drain a hill side of this description, it is proper to begin by making a trench along the upper side of the uppermost wet and rushy soil, which will have the effect of cutting off the highest spring; but as the rain, and other water that may come upon the next portion of porous soil, will subside to the lower part of it, and form another spring, which may likewise be partly supplied from some internal source, a second cut or drain must be made in that part, to prevent the water from injuring the surface of the succeeding clay beds. Thus, similar cuts will be necessary, so far down the declivity as the same springs and appearances continue, and which, on the whole, may afford a supply of water to the stream in the hollow, that may be useful for several purposes. See plate No. XII. line marked C.

In some hills, the strata of which they are formed lie so regular, that it is possible to draw the water from either side on the same level; which, in many cases, would be of advantage, by draining the one side, and procuring water for the other; for there is often wet and swampy ground on the one side, while the other is too dry. This is owing to the retentive body of clay, which keeps up the water, not being disposed in a horizontal direction, but having a dip or depression, a little more to one side than to the other, and from the dry side being overlapped by a covering of clay, by which the water is forced to issue at the open side; but when an outlet is made for it on the dry

PLATE XIII.—*Drainage of hills, procuring of water for wells, &c. &c.*

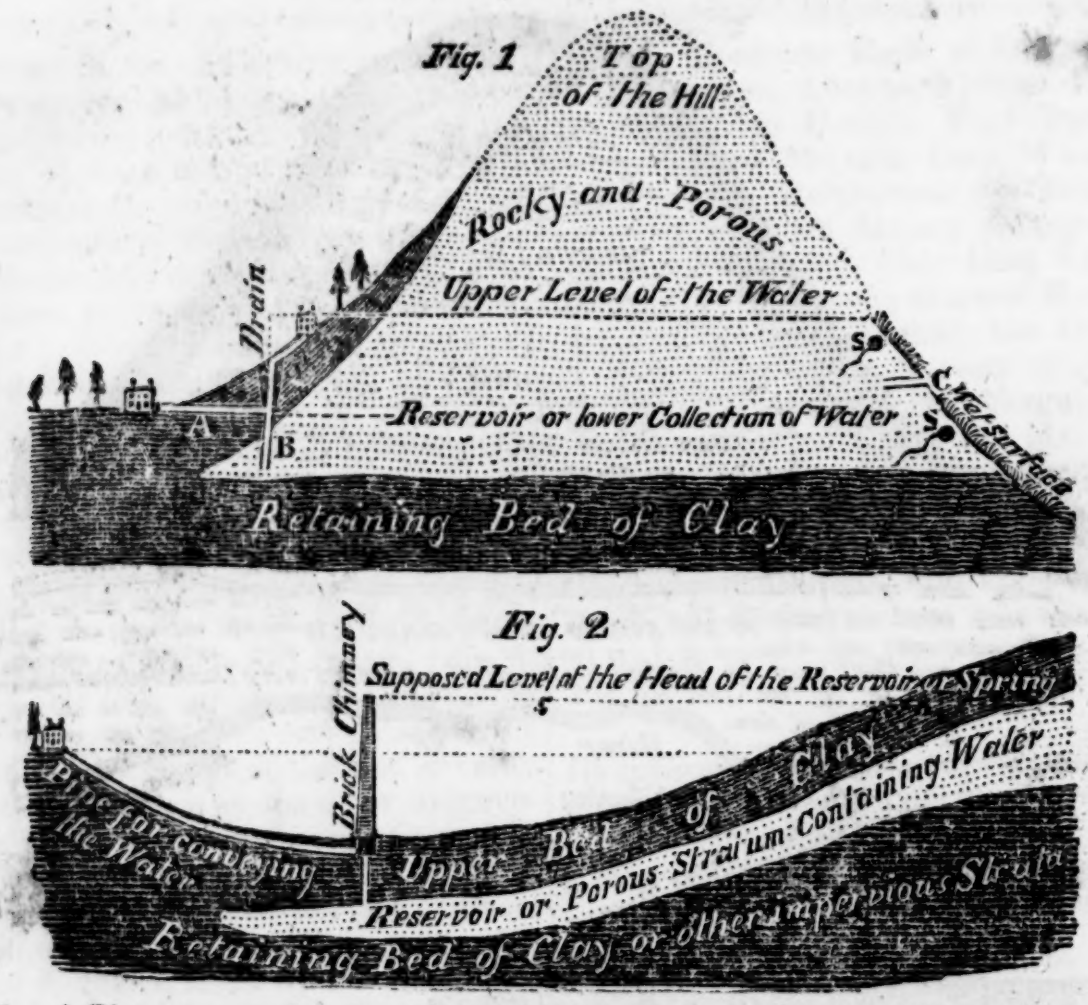


Fig. 1.—A Pipe or covered drain. B Auger hold. C open sandy side hill. S S Springs.

side, by means of a drain and boring, lower than that which it naturally has on the wet side, the course of the spring may be thereby diverted. The opposite side being porous and sandy, it becomes a reservoir for the rain-water, which will afterwards discharge itself at the artificial opening made on the other side—a circumstance that may be useful for domestic purposes, when a house is set down on the dry side of a hill. See figs. 1 and 2, of plate No. XIII.

The principles of this system may be often applied with advantage in the procuring of water for wells, &c., in situations where it does not appear practicable to a person unacquainted with them.

A spring in a low situation adjacent to higher ground, may be raised to supply a house or any other useful purpose (although much below the level), by confining it in a pipe, or water-tight brick chimney. The reservoir from whence the spring or outlet of water is supplied, being confined and pent up between two retentive strata, and the upper part of such reservoir extending perhaps to a considerable height and distance in the high ground contiguous, it is evident, that if a perforation be made through the superincumbent stratum into the lowest part of that containing the spring, the water may be raised to nearly as high a level as the head of its reservoir, by confining it in a pipe or other close conductor. See fig. 2 of plate No. XIII. Of this, several instances occurred in Mr. Elkington's practice; particularly near Warwick, where he raised the water, procured from draining a low meadow, into a mill-lead a considerable height above the level of the drain. The conduit is closely built with brick, and so puddled with clay at sides and top, as to make it so perfectly water-tight, that not a drop can escape, though the pressure be considerable. The water rises through a perpendicular brick chimney (also water-tight), and is discharged into the lead. Two similar cases have occurred during the author's practice.

The advantages of such operations must be very great in many situations, and may often be accomplished with success, though some may think them impracticable.* Of the practicabilty of this, however, and that water will rise to a very considerable height by means of its own pressure in high and distant ground, the following remarkable occurrence, which happened in digging a well in the vicinity of London, is a proof: Earl Spencer, for the preservation of his noble mansion at Wimbledon against fire, ordered a well to be dug at a little distance from the house, which was sunk to the amazing depth of *six hundred feet* before any spring was found! It was begun on 31st of May 1795; and, on the 12th of August 1796,† the man who was employed in the *undertaking*, gave a signal to the person above, to *draw him up*, as he had found the spring, and was immersed in water so deep that his life was endangered. In the space of *four hours*, the water rose to the height of *three hundred and fifty feet*, and during two days following, its increase was more than a foot an hour. The water proceeding from rock, is remarkably fine, and, from the strata it passes through, is strongly impregnated with mineralic qualities. The sinking of this well alone cost his lordship two thousand pounds, but will recompense him by its utility; as, before it was done, the only supply for the family was either rain fall-

* Experiments in Mr. Elkington's mode of draining, and in procuring water by boring, &c. successfully made by sir Joseph Banks, are described in the enlarged Agricultural Report of Lincolnshire.

† The author was at Wimbledon nearly about this time, where he ascertained the above particulars.

ing during the wet weather, or water procured from the adjoining fish-ponds. As there is no extent of higher ground near that where the well was sunk, and as the depth of it is some hundred feet below the bottom of the Thames, the source of the reservoir from whence the spring is supplied, must be situate at a very great distance, and must contain a very large and permanent body of water, to raise it so suddenly to such a height, and continue to supply it. Great care is necessary in conducting a drain for procuring and conveying water for the supply of a house, &c. It should neither be cut nor bored into so deep as to reach a *second* porous stratum; otherwise the water that may have been *found* in the one, may be *lost* in the other. Puddling may, in some degree, secure it, but not in every case. Another thing should be attended to in digging wells for a permanent supply of water: although a plentiful flow is found in the sand or rock through which the pit is proceeding, before the bottom of such sand or rock is come at; yet, for the greater security of always *retaining* a sufficient supply, it is proper to dig so far into the clay, or other impervious stratum, by which there will be no risk of the water being lost in a dry season.

There are many valuable tracts of land, called *holms* or *haughs* in Scotland,* wet, and covered with rushes, which, when reclaimed, are by much the most fertile and productive of any. As land in this situation requires particular treatment, and cannot be laid perfectly dry without attending to other circumstances than that of merely making drains through it, it is necessary to describe these minutely.

The land alluded to lies along the sides of rivers or smaller streams, which, having frequently altered their course between the opposite banks, deposite sand, gravel, and other alluvial soil, as they recede from their last channel, forming a *haugh* or flat piece of land, in many situations, of considerable extent. From the nature of the materials of which the soil of this ground is formed, it is evident they must be in a great degree porous, and easily admit the reception of water; for if a pit or drain is dug in such ground, it immediately fills with water to the level of that in the river. Where the river has a quick descent, it is less apt to produce wetness in such haughs; but where its current is slow, and the level of its water little below that of the surface on either side, the soil will consequently be very much saturated with water. Any number of drains, therefore, cut in any direction, can have little effect, while the water of the river continues so high in its present course. The only remedy in this case, when it can be done at a moderate expense, is to deepen and widen the channel of the river or burn, the earth taken from which will serve to form an embankment on the sides; for while it can rise higher than the outlet of the drains, and flows back into them, the ground becomes equally wet as before, and the expense of making them is laid out to no advantage. Where there is only one stream, running in a serpentine or crooked course, it may be advisable to cut for it, a new, straight, and deeper channel; and even if there be other runs which the water follows, these may be all directed into the new course. The earth from the new cut will level up all the old runs and hollows.

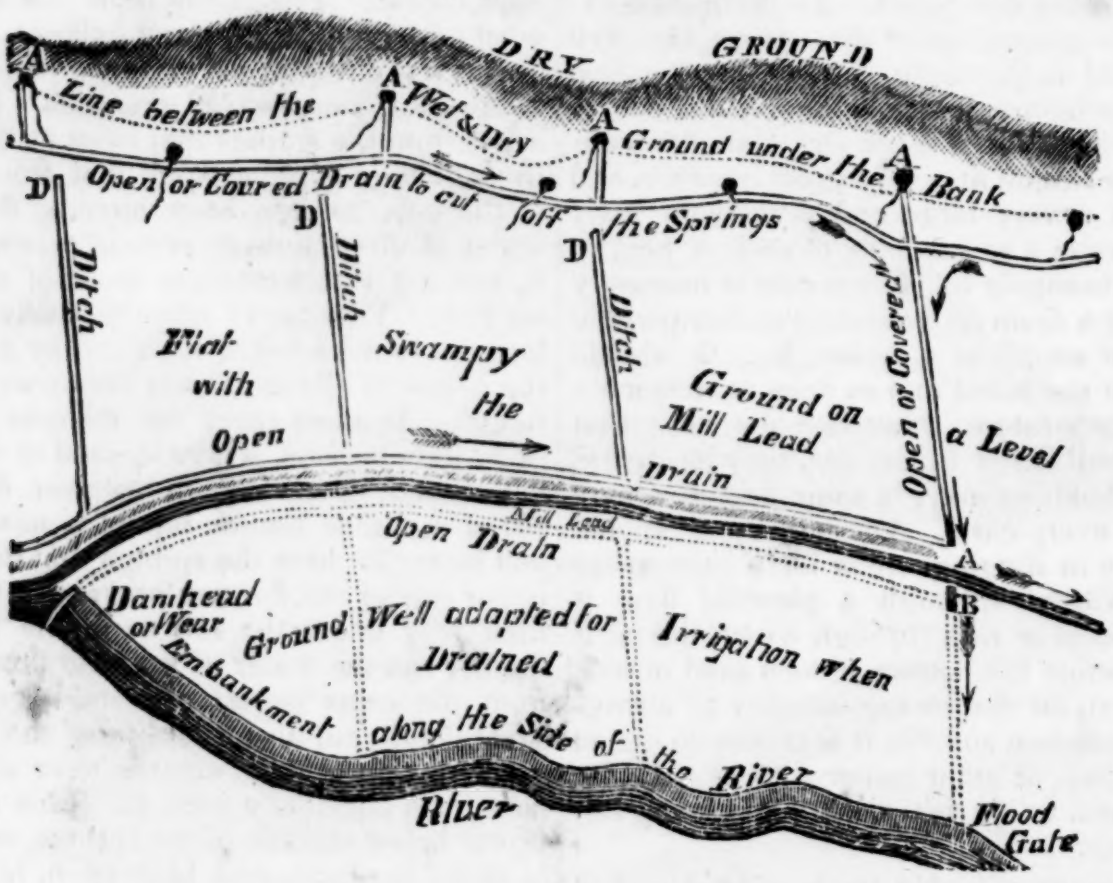
But it is not from the river water alone that the wetness of haugh land proceeds. It frequently arises from the springs that issue at the bottom of the adjoining high ground; and from the nature of the soil, as has been already described, the water of these springs percolates easily through it, keeping it in a constant state of moisture and sterility. This water may be easily cut off and lowered to the level of the river, by a drain along the course of the springs at the upper side of the haugh. In some cases the wetness proceeds entirely from springs, where the soil of the haugh or flat ground, all the way to the river, does not consist of a porous nature, but of a mixture of clay and loam; for here the springs that rise along the upper side of the flat, are prevented from finding their way under the soil as in the former case; neither can the water of the river flow *through* it, from the same cause: a drain, therefore, of no great depth, cut along the line of the springs, and discharging its water into the river at the lowest point, will effectually cure it. This drain should be cut below the line of the springs, or immediately under the bank, and kept open, to receive the *back flowing* of the river in time of floods; and likewise on account of any runs of surface water from above, that may also be augmented in time of rains, and which would choke and destroy it if covered. From the drain under the bank, which may in some places not draw down the springs, and therefore leave the face of the bank equally wet as before, small cuts may be made up to them, (if boring opposite has not that effect), as represented by the letters A, A, A, in Plate No. XIV. (See next page.)

There will be no occasion for any cross drains between this upper one and the river, as all the water will be intercepted by that along the bottom of the bank, and conveyed by it to the nearest and lowest part of the river; unless the ground is of such extent that it may be advantageously divided into separate inclosures; in which case, the upper drain will serve as a division between the higher and lower ground. The drainage of many tracts of land of this description is reckoned impracticable, when a mill-lead, or other artificial run of water, passes through it, or along the side to which the fall inclines. The low situation of the ground, and the height of the lead, prevents the practicability of discharging the water of any drain into it, that might be cut to the proper depth. The drainage, however, of this ground may be managed, by conducting the water *under* the lead to the nearest outlet. A drain should be therefore begun at the river or natural stream, and brought up to the lead, at the point where the outlet of the upper drains is to cross it, of such depth as the river admits, and the upper drains require. A cut must then be made across the lead to the same depth, and a strong wooden box, of sufficient size to admit the water, collected above, to pass through, placed across the lead, as at AB, in plate No. XIV.

The length of the box or trough must be several feet longer on each side than the width of the lead, and must have stakes driven in at the sides, with bars across, to keep it secure. The space betwixt the top of the box and bottom of the lead

* In England, for most part, called meadows.

PLATE XIV.—*Draining of holms or haughs on the side of rivers.*



must be filled with clay, well beaten down.* This done, the drain, from the passage under the lead, is to be carried upwards to the same depth, and along the line of the springs already described; and may either be open or covered, as the extent of the ground or other circumstances point out. From the box, also, an open cut will be necessary, parallel to, and along the *upper* side of the lead, to intercept any oozing from it, and to receive the surface water from the ground, or from any cross ditches that may be made in it. The earth from this cut should be laid towards the lead, to strengthen and secure its bank on that side. An open cut will also be useful along the *under* side of the lead, to receive any water that may flow from it, and which may injure the ground between it and the river; and this ground may likewise be divided as that above, in the manner represented (by *dotted* lines) in the plan. The cross or division ditches, in the upper part of the ground, should not join the upper drain; but a space should be left, uncut, at the letters D, to prevent any connection with the upper drain, and to serve as a passage from one division of the field to another.

* In the course of the author's practice, several cases have occurred, where he had recourse to this expedient, as the only practicable means of effecting such drainage.

If the extent of ground, in the situation which has been thus described, makes it an object of consideration, it may be necessary to form an embankment along the side of the river, with a flood-gate at the mouth of the outlet drain, which will effectually exclude the river water when in flood, and will open, by the pressure of that collected in the drain, as soon as the flood subsides. From its nature and situation, ground of this description is well adapted for irrigation, where the stream or supply of water is sufficient.

Such are the principal situations and soils to which this particular system of draining applies, in cases of wetness proceeding from springs, according to their various appearances. To inferior spots of wetness, produced by the same cause, which are so frequently met with, and so much interrupt the regular cultivation of many fields, it equally applies; but its application in these cases is a matter of so little difficulty, that a particular description of them is not necessary.

SECTION IV.

Its application to the drainage of mines and quarries.

The principles of this mode of draining, have hitherto been applied only to the removal of water that causes wetness on the surface of the

earth; but there is no doubt, that, in many cases, it might prove equally successful, and be of essential importance in those of mines and quarries, where the workings are often obstructed by a flow of water, which might be diminished before it reach the mine, and be partly got quit of, when it does reach it, in a manner more easy, and as effectual as by the ordinary methods.*

It has been explained, that all springs and subterraneous collections of water, are supplied from ground lying higher than that where they are found, though which the rain and other water descends, following the course of such rock, sand, or gravel, as far, or as deep, as they extend. Thus, in sinking a pit for coal, or other mineral, near the bottom of a hill or eminence, a bed of quicksand is often met with, so full of water, that to pass through it becomes a tedious and difficult operation. As this water must come from the higher ground, above where the pit is sunk, it may be possible to intercept the greater part of it before it reach the sand bed; and if the ground declines lower than the level at which the sand bed appears in the pit, by a drain and boring, the whole water may be drawn from it at that lower point. To accomplish this object, it will be necessary to ascertain what strata lie above the place where the pit is sunk; and, for that purpose, it will be proper to examine if the termination of any bed of rock, sand, gravel, or other porous substances, appears higher on the acclivity, which may convey the water it contains to the inferior strata through which the pit is to be sunk. If one or more of these beds are found, and water issue from them, as may be seen by the surface, a drain should be cut in the manner already directed, which will carry off a great part of the water, and consequently lessen the quantity in the pit or mine. But, when this is done, and the supply from above thereby diminished, or nearly cut off, still a quantity of water that may be troublesome will flow from the sides of the sand bed, which, however, may be drawn off at some point in the low ground. To ascertain this, it will be necessary to examine, from the pit, along the declivity towards the lowest ground, in order to discover whether the sand bed continues lower, and at what point it terminates. This may be found by applying a spirit-level; and if it appears that at that point the water has a natural outlet, it may, by means of a deep drain, or boring, be more quickly and effectually drawn off; for, as a natural spring, it may have only a narrow and slow passage, but where a larger and lower opening is made, the water will discharge itself in greater abundance.

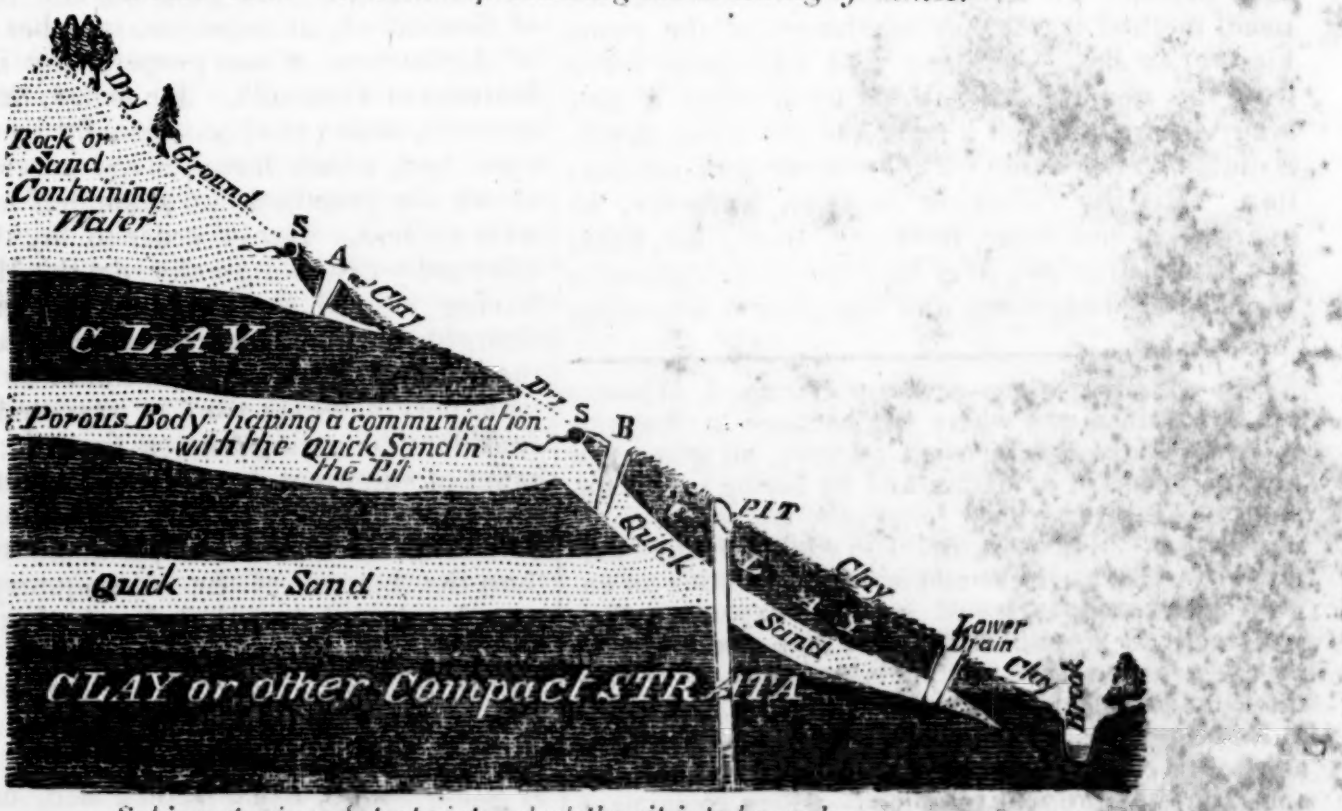
This operation may tend, in a great measure, to remove, or at all events will relieve the difficulty that might afterwards attend the sinking of the pit, and also the workings below; for the water thus cut off might have found its way downwards, passing from stratum to stratum, so far as such continued porous, or capable of receiving it.

It is therefore of material advantage to drain all ground lying higher, or contiguous to subterraneous pits and mines; and, on these principles, and by these means, it may be done with little difficulty or expense. Water found in the bottom of the pit, or in the course of the mine, must be got rid of in a different manner, as the ground may nowhere decline so low as to be under that level; for it is only on the supposition of the different strata and sand bed having the same inclination with the surface, or lying nearly horizontal, that the above is practicable; but, if they lie in a reverse position, there is little hope of accomplishing the object, unless their ermination can be hit on somewhere in the opposite side of the hill, which, by exact levelling, and ascertaining the precise inclination of the metals, may be found out. See Plate No. XV.

The water which collects in the mine itself, in the course of working, can only be got rid of by

* By expensive engines for the purpose of drawing it up.

PLATE XV.—*Section representing the draining of mines.*



Subjacent mineral strata into which the pit is to be sunk.

A, Drain cut into the tail of the sand, or rock—N.B. This will cut off the water which flows out of the rock, or sand, and which, after running over the surface of the clay, is absorbed by the next porous soil, through which it descends into the quick-sand that impedes the sinking of the pit, or excavation of the mine.

B, Drain cut through the sand bed. S S, Springs.

means of an engine and pump for that purpose ;* but that it is also possible to give it a discharge, by boring downwards, the following extract from the Agricultural Report of Hertfordshire will show:—"The water was raised by a steam-engine about sixty yards, from a colliery in Yorkshire, which had been wrought several years; the proprietors bored down to the depth of about ten yards farther, to ascertain the depth and thickness of a seam of coals, which was supposed to lie below those then wrought; the workmen employed, bored from the bottom of the pit, next the engine pit, and when they had bored to the above depth, and taken out the rods, the water from the works, which usually ran across the bottom of this pit to the engine-pump, ran down the hole they had then made. As soon afterwards as the steam-engine was set to work at the stated period, (about one hour in twelve,) the engine-pump contained little or no water; it had escaped through this hole, and continued to run through the same ever afterwards, and rendered the engine useless. This instance of water, at so great a depth from the surface, finding a passage at a further depth of ten yards, and immediately below, is very singular and striking. The situation was much higher than the next adjoining valleys, and the level of the sea. Experiments of this sort seldom fall to the lot of man to make, therefore such instances are rare and uncommon. But in large tracts of level land, where lakes or morasses have been formed, and which cannot be drained by cutting open drains, or driving levels through rocks, but at an expense for which the lands, when drained, would never compensate. the above instances warrant experiments being tried with boring rods, which, if not successful, may be tried at little expense."

In working quarries of lime and freestone, frequent interruptions happen from water at a certain depth; and, as the stone commonly improves in quality, the deeper it is wrought, it becomes a matter of importance to get rid of the water at that depth. To remove this inconvenience, the usual method is to apply machinery of the pump kind, or to bring up deep and expensive levels from the nearest declivity, or by opening a new quarry, which, when it comes to the same depth, is liable to the same inconvenience and obstruction. By the following method, however, all quarries of limestone, freestone, marl, &c. liable to such obstruction, may be completely cleared of water at little expense, and the ground adjoining, at the same time, laid dry by the drain which is to draw off the water from the quarry. Immediately under the rock, there is generally a bed of retentive clay, that upholds the water received and retained by that rock; and where the rock terminates at the surface of the declivity, it is also overlapt by a covering of clay, or other impervious soil, through which the water can have no natural discharge, and therefore stands up to such a level in the bed of stone, as renders it difficult to be wrought at that depth.

In the first place, endeavor to find to what side the rock has its dip or inclination, and follow this to its termination near the surface, by tracing it along the descent, which the aid of the spirit-level enables one easily to do. Having thus discovered the point to which the termination of the rock approaches, cut a drain there through the clay, which will give a discharge to the water as soon as it meets the rock. To render it more effectual, the drain should be cut a good way into the rock, which, at that place, is generally of a soft and loose nature, and not difficult to excavate. See Plate No. XVI. Figs. 1. and 2.

It often occurs, that in the disposition of beds of stone, they vary considerably in their nature and texture, so that a porous part of the rock may be succeeded by a stratum of so close and compact a quality, that no water can get admission into it; and, indeed, it is almost always the case, that the deeper it lies, the more solid in consistence most kinds of rock are. When this happens, the natural consequence is, that the more porous part of the stone is full of water, kept up by the retentive nature of that below. It is often the case, also, that under this lower compact bed of stone, there may be sand, gravel, or other dry porous matter, capable of absorbing water; and when such is the case, an easy discharge may be given to the water, by boring through the close bed of stone to the absorbent strata underneath. See Plate No. XVI. Fig. 3.

The success of both these experiments, is proved by a communication from the late Mr. Eccleston of Scarisbrick, an ingenious member of the Board of Agriculture, whose property lay in the neighborhood of Ormskirk. He states, that, "In stone quarries, wells (pits) occasionally are sunken to the open bed, which have proved serviceable. The above was practised in a stone delf near Ormskirk with success. But in order to lay the delf more effectually dry to a greater depth, Mr. Elkington having viewed the country, marked where he thought the rock terminated, or tailed out, and, at the lowest level, set out a drain to be cut up to the rock, part of which work is executed, and a very considerable spring comes from it: but, on account of the great depth (sixteen feet), it will not be finished before he has seen the work again. The drain he has laid out, is about ten feet lower than the bottom of the stone-quarry, and when completed, will lay that head of stone dry, ten feet lower than the present floor. Most rocks, where they terminate, are succeeded by broken loose stones, of the same nature as the rock; and they are frequently (not to say always) succeeded by sand, which, when a thick bed, and of a running nature (quicksands,) often cause great expense to cut through to the tail end of any rock." In such cases as this, where there is a chance of meeting with quicksands, boring, or sinking pits

* In situations where a proper command of water can be obtained, and where the entrance to the mine is likewise favorable for such purpose, all water that may be collected by drains, and by boring in the upper grounds, will not only relieve the minerals from its obstruction, but may be useful in adding to any natural stream that might be employed in working an engine-pump; and so would be less expensive than working it by steam. Machinery may also be driven by water for bringing out the minerals; as is done at the Duke of Buccleuch's coal-works near Langholm, in Dumfriesshire, which are a perfect example of the above, and of the superior powers of water and machinery, when properly combined—where a command of the former can be obtained, and when the latter is constructed on proper principles, and conducted with that care and ingenuity which are necessary in such undertakings.

PLATE XVI.—*Drainage of quarries.*

Fig. 1 & 2.

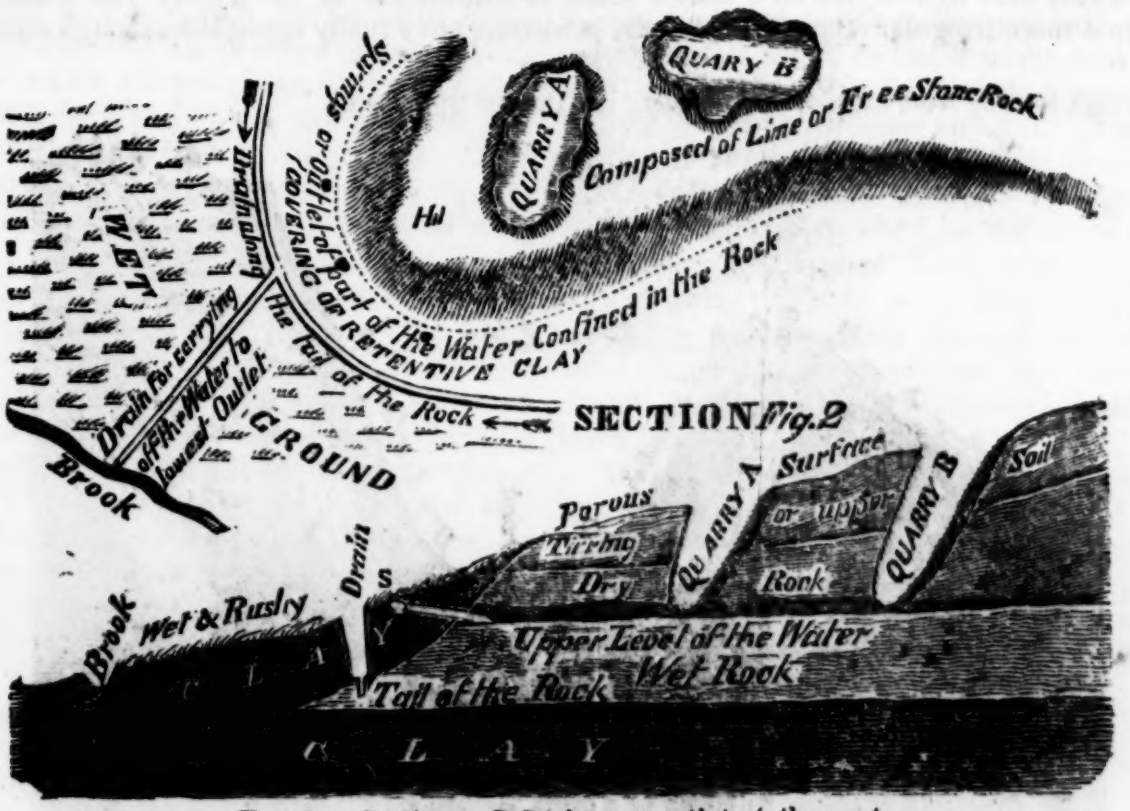


Fig. 2.—*Section.* S Spring or outlet of the water.

Fig. 3.

Perhaps under this clay bed, there may be another dry porous stratum into which the water may be let down, and reduced to a still lower level; and this may be ascertained by boring an auger hole through the clay.

through the bed of close stone in the quarry itself, is the most advisable and least expensive method.

The situation of marl pits is commonly such, that it requirs a very extensive cut through some part of the surrounding bank, to carry off the water that prevents taking out the marl. This might often be accomplished in a much less expensive manner, by sinking a pit, or boring through the retaining stratum under the marl bed, into some absorbent stratum below, that would receive the water let down into it by the pit or auger holes. If the ground where the marl lies is of considerable extent several pits or borings will be necessary to carry off the water. If such pits require to be so deep as to be in danger of closing up by the sides falling in, they should be built round the sides, or filled up to near the top with loose stones, through which the water can quickly and safely subside. Any cross drains, or cuts necessary for collecting the water, must be conducted into the pits. In many cases, the water may be got rid of in a still easier manner, provided the situation of the ground is favorable. If the surrounding bank declines on the opposite side *lower than the water*, by cutting a drain into it, or boring with a *horizontal auger*, into the *tail* (lowest termination) of the stratum containing the water, it will be drawn off and reduced to a level lower than that of the bed of marl. As this water is often supplied by a spring, rising in some part of the higher ground, and descending into the place where the marl lies, in such case it will be necessary to cut off the source of this spring, and divert it into some other channel. By doing this, the quantity of water below will be lessened, and more easily carried off by means of the pits, drains, or auger holes.

There are no pits of rock or clay marl in Scotland, like those in England; but the same method of freeing them from water applies in all similar cases. In many parts of England, much good land is lost, by leaving these pits to remain full of water, when they might be so easily laid dry by the means thus described.

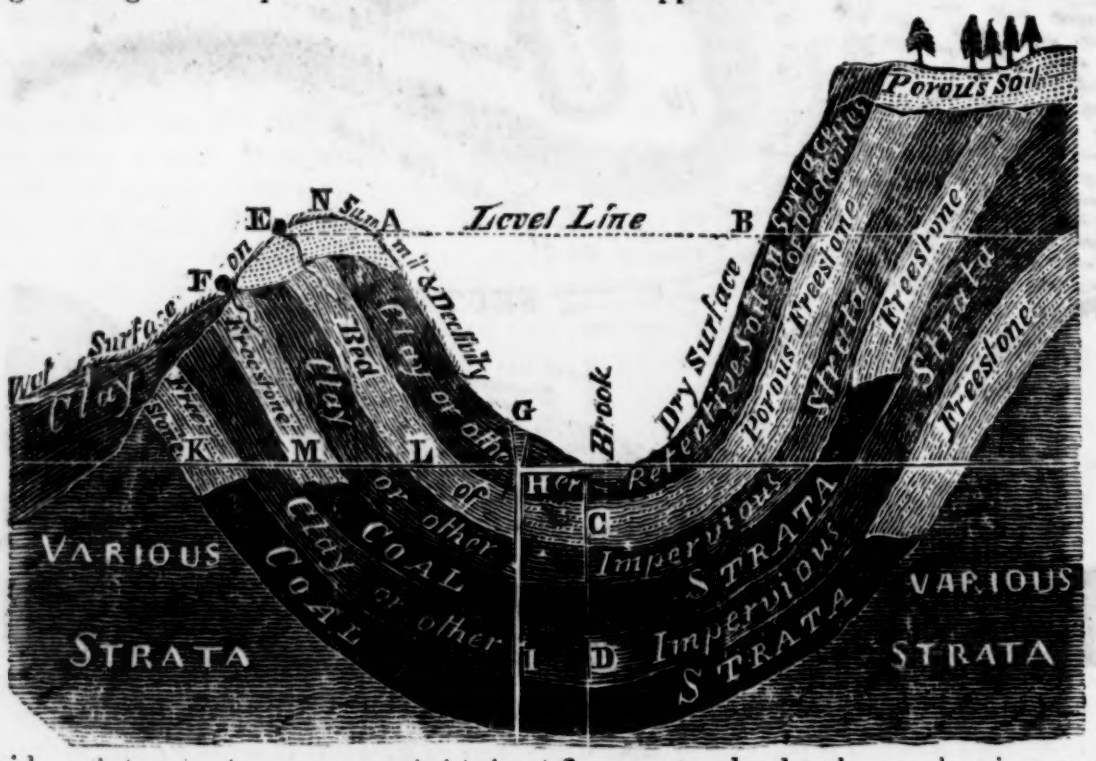
Springs (and consequently wetness) are sometimes found on the top of banks, and even hills, where the ground immediately contiguous is lower on all sides; but such springs are supplied from higher ground at a distance, by means of water conveyed through the beds of porous freestone, in the manner represented by Plate No. XVII.

The continuation of the strata C D is supposed to keep on the same rise, in the higher ground on

PLATE XVII.—*Drainage of springs on the tops of hills or high ground, and of mineral strata.*

N. B. The expanse of the valley, or distance between the high ground, may, in most cases, be very considerable; but it is here represented on a narrow scale, to suit the size of the plate. The strata, too, may be found to lie in a more irregular disposition; but the *principles* are equally applicable, though other circumstances vary.

E F Springs issuing from crop of the metals. N Porous upper soil.



the opposite side of the rivulet, to a much higher level than the line A B, by which means the springs at E F, issuing from the crop of the metals, are supplied. By bringing up a cut from the brook or rivulet into the bank at G, an outlet will be given to the water, free from that of the stream; and, by boring, or sinking a pit, from H to I, the water flowing through the porous strata from C D to E F, will be reduced to the level L M; consequently, the course of the water supplying the springs E F, will be intercepted, and the ground on the summit, and on both sides of the declivity, become dry; and the coal, or other mineral, may be wrought out, free from any interruption of water. This could not be effected by boring from the bottom of the rivulet (as shown by the dotted line), for the pressure of the running water above, would prevent that below from rising freely, and small stones or sand would be lodged in the holes, and completely obstruct its issue. If the strata, K, crop out to the surface and cause wetness, the pit or bore, H I, may be continued till it reach it; but, lying at such a depth, the water contained in it cannot affect the surface, or do any injury to the ground; and is only necessary, if a lower bed of coal, or other useful mineral, is to be drained.

Postscript.

After this Treatise had been *printed off*, the author received the following information, which tends to authenticate the theory which he has endeavored to establish, respecting the origin of springs in high, and in low situations. Those arising to the surface in the interior of a country, which are the sources of rivers, brooks, and lakes, may be amply and perennially supplied by the rains and dews that fall on the surface; but, those that are found at great depths under the level of the sea, as stated respecting the well at Wimbledon,* and the coal-pit to be here described, confirms not only the theory, but is a practical demonstration that great bodies of water are situated in the subjacent strata of the earth, for the supply of which these sources (rain, snow, and dews,) would be altogether inadequate.

The deepest perforation that has ever been made into the internal strata of the earth, has been recently performed in the sinking of a pit or shaft at Monkwearmouth† Colliery, near Sunderland, in the county of Durham. The bottom of the shaft is already 1500 feet below high-water mark, and 1600 feet below the surface of the ground!! This shaft passes through limestone, and free-stone sand, to the depth of 330 feet, from which is discharged the prodigious quantity of 3000 gallons of water per minute, for the raising of which, a double acting steam-engine, working with a power of 200 horses, is found requisite! The first stratum of the coal-formation was found at the depth of 344 feet; but of an insignificant thickness.

A new feeder of water was found at the depth of 1000 feet, requiring additional pumps to clear it. In the expectation of reaching a very thick and valuable seam of coal at the further depth of 200 feet, this wonderful pit is still progressing downwards. To the geologist, this is a subject of great *interest*, whatever it may *turn out* to be, in point of *profit*, to the spirited proprietors and undertakers.

It is a proof that large bodies of water exist in the subterraneous strata to an indefinite depth; hence originate those larger and perennial springs that rise in hollows, or close to the sea. The degrees of heat in this pit were carefully ascertained by barometric and thermometric observations, and were found to increase according to the depth. Though rather a *deep* subject even for speculation, perhaps in coal strata of great extent, or in those that lie *above* or near them, these reservoirs of water are provided for the purpose of counteracting subterranean fire, and preventing volcanoes!! That water, *direct from the ocean*, has found en-

*The *Wimble* (auger) might have been *well* applied in this case, in perforating the lower strata; by which operation, much time, labor, and expense, might have been saved.

†It was begun in 1826, and may be completed in 1835.

trance into large caverns of the earth, the many salt-springs, and rock-salt, that are found in England and other countries, are positive proofs. Water, from the same source, may have its saline quality modified, by filtration in the different pervious strata through which it may pass. This might, to a certain degree, be ascertained, by observing if the water in such a pit, shaft, or well, rose no higher than the surface of the sea; and if it rose and fell according to the flow and ebb of the tide.

Along the shore, at low-water, may be seen very strong springs, issuing from the rock, between Portobello and Fisherrow, the feeders of which lie in the Pentland and Braid Hills, and intervening eminences. These springs could be raised to a considerable height by means of compression, as described in page 704, and fig. 2d, Plate XIII., and might be thus converted to useful purposes,—there being few or no *pure land-springs* in that locality. The Frith of Forth being bounded in this quarter by a strong barrier of clay, no spring-water can have exit, unless where that boundary is broken by intervening strata of sand or rock, which is the case at the places alluded to.

In a future essay, (which the auther has in contemplation), this will be treated of at large; and wherein will be given, geological sections of the country from the Pentland Hills to the Frith of Forth, illustrative of the subterraneous passage of water from its highest feeders to its lowest outlet; forming a succession of swamps (at one time lakes,) according to the nature and inclination of the strata, from the most distant receivers to the level of the sea.

A cut and conduit, laid out by the author, across a bog in the vicinity of St. Andrew's, has just been completed (December, 1834), for the purpose of procuring a supply of spring water for that city. This drain, although little more than 400 yards in length (that part of it in which the water is found), produces 27 Scotch pints per minute, being *three times more* than *three times the length* of cuts and pipes, from wells in the same ground, produced before. Its depth is from six to ten feet, passing through a super-stratum of peat earth and clay; it then reaches a bed of free stone sand, from which the water flows. This drain effects a *double* purpose, that *of laying the land dry*, and *supplying the city with good water*. Plan and section in Plate XI, is a near representation of it. In the above case, it was unnecessary, and might have been hazardous, to use the auger, the quantity of water found in the drain being sufficient for the purpose required; and the situation being such, on the sloping declivity of high ground near the sea, there was a risk of losing the water, by letting it down into some subjacent absorbent strata, below the level of the city.—*See* page .

SECTION V.

Description of the auger and spirit-level, with other implements for draining; and the manner of using them.

The borer, used in draining, is nearly similar to that made use of in searching for coal, or other subterraneous minerals. The auger, shell, or wimble, (as it is variously called), for excavating the earth and other strata through which it passes, is about three inches in diameter; the hollow part of it, one foot six inches in length, and constructed nearly in the shape of the wimble used by carpenters: only, the sides of the shell come nearer, *i. e.* within an inch of one another. The rods are made in separate pieces of four feet long each, that screw into one another to any assignable length, one after another, as the depth of the hole requires. The size of these, is an inch and quarter square. There is a chisel and punch for screwing on, in going through gravel, or other solid materials, to accelerate the passage of the auger, which could not otherwise perforate such hard bodies.

The chisel is two inches and a half broad at the point, and made very sharp for cutting stone; the punch is about an inch and half square, also sharpened at the point, for piercing gravel, &c. There is a double cross handle at top, and two iron keys for screwing and unscrewing the rods, with a small instrument fitted to the hollow part of the shell, for cleaning it when full. The manner of using it is thus; and for the most part, it requires four men to work it effectually. When the auger is full (which is easily known by the depth), they draw it out, and the man in the bottom of the drain clears out the earth, directs it again into the hole, and can assist in turning it with the iron key, and also in drawing it out, when the depth and weight of rods require additional force for that operation. The workmen should be cautious in boring, not to go deeper at a time, than the length of the shell, without drawing it up; otherwise the earth, clay, or sand, through which it is boring, closes above it when full, and makes it very difficult to pull out. For this purpose, the exact length of the shell should be regularly marked on the rods, from the bottom upwards. A platform, made of strong boards, with a hole in the centre, is laid over the drain in time of boring; it being useful for directing the rods perpendicularly; for keeping them steady; and for the men walking on, when turning the instrument round. The men, in boring, lean upon the handles, and walk round, which gives more pressure and effect to the instrument, than standing when turning it round. With additional machinery for drawing it out, the auger is used in boring for coal, &c. to the depth of several hundred feet.

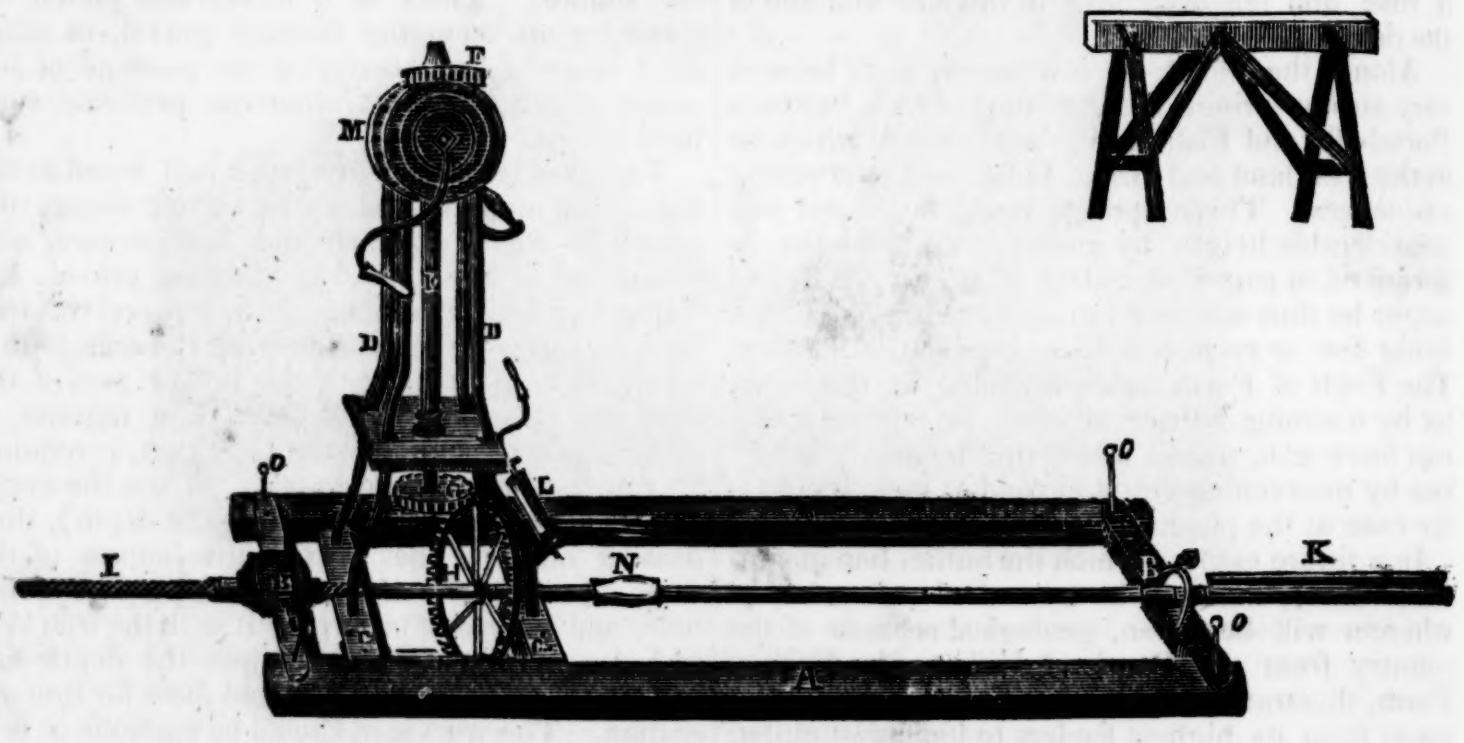
There has been a horizontal auger invented by Mr. Haford of Hathern, in Leicestershire, though not in very general use. The advantages of it are in many cases considerable, by lessening the expense of otherwise cutting; and its performing the work in a much shorter time. Where a drain or water-course has to pass under a house, bank, road, hedge, wall, rivulet of water; or for drying marl pits, quarries of stone, &c. it may be used to advantage, in excavating a sufficient passage for the water without opening a trench for that purpose. In laying leaden pipes for the conveyance of water, it is also useful, in making an aperture through which the pipe may be drawn, without opening a cut from the surface.

For tapping springs, or finding water at the bottom of a hill, either for the supply of a house, or for draining the ground, it may be used with sucess, as the water of the spring, when hit on, will flow more easily, and in greater abundance, through a horizontal or level, than through a perpendicular outlet; also in boring through any re-

taining bank, to draw off the water from ponds, marl-pits, &c.

The manner of using it is thus: Suppose a lake or pond of water, surrounded with high banks, is to be emptied; if the ground declines lower on the opposite side, find the level of the bottom of the water, and trace that level to the face of the bank where the perforation is to be made. There, smooth the surface of the ground, so as to place the frame nearly level, with the auger pointing a little upwards. It requires two men to turn the handles at top, in order to work it which may be better understood by examining the plate. When the auger or shell is full, the rods are drawn back by reversing the lower handle, and other rods added in succession, when the distance re-

PLATE XVIII.—*Horizontal auger and trestle.*



Explanation.

A A, Frame grooved within, 8 feet 10 inches in length. BB, Ends of the frame, 2 feet 10 inches, through which the screw and auger passes. CC Bottom of the carriage to which the uprights are fixed. DDDD Upright standards 4 feet high. E. Spindle 2 feet 10 inches long. F. Upper cog wheel with 10 teeth. G. Lower cog wheel with 24 teeth. H. Main wheel with 32 teeth. I. Screw, 6 feet, 3 inches. K. Auger, 6 feet long, and 3½ inches diameter. L. Winch and roller for reversing the rods. M. Two conright or side wheels with 24 cogs each, upon which the two handles are fixed. N. Joint for lengthening the rods.

Two strong wooden trestles, (like the one in the cut) about 2 feet in height, are placed under the ends of the frame for it to rest on, and to keep the instrument steady and at the proper level, during the operation of boring.—O,O,O,O, Moveable bolts for fixing the frame to the trestles.

quires, in the same manner as is done with the perpendicular auger. In boring through a bank of the hardest clay, two men will work through from thirty to forty feet in a day, provided there is no interruption from hard stones, which will require a chisel to be fixed on, in place of the shell, and longer time to work through them. If the length to be bored through is considerable, under a level surface, or longer than the whole length of the rods can reach, a pit must be sunk upon the line, down to the level of the hole, for placing the frame when removed, and the operation is then carried on as before.

It is a powerful and useful instrument, and if better known, might soon come into general use. The annexed plate, and description specifying the dimensions of its various parts, may enable any ingenious tradesman to construct it accordingly.

The other implements used in cutting, and in ceasing out the contents of the drain, are, besides the common spade and shovel, those represented in the Plate No. XIX.

The spade made of oak, and scooped out in the middle, is used in peat, and other soft soils, being light and easy to work with, and the edges preventing the stuff from falling off, when throwing it out of the trench. They are made of iron in the same shape also, for throwing out heavier stuff, when the drain is deep. The crooked handled spade, or shovel, is well adapted for smoothing the bottom, before laying the conduit, and with which the workmen have less occasion to stoop.

As the usual opening of the conduit in stone drains is from six to twelve inches square, a wooden box of that size, a yard or two in length, is very useful for laying in the bottom of the drain, to regulate the width and height of the building, and which is shifted forward as the workmen proceed. It also keeps their feet dry, and prevents their puddling the bottom.

The level used in draining is the common spirit-level, employed in the ordinary levelling of ground. Being provided with one that is properly adjusted, and also with a staff ten feet in length, with a moveable vane or sight affixed to it; set the instrument in a situation between the point from whence the level is to be taken, and that to which it is to be directed, provided the distance from the instrument to each is not too great. The situation of the instrument should be no higher than the length or height of the staff will answer; but so, that it may be seen from it both ways; then direct the man to hold the staff at the spring, or place from which you mean to carry the drain; and after directing the telescope to it, and adjusting the level, make a sign to him to move the sight up or down, till it correspond exactly with the cross hair in the telescope. This done, without shifting the instru-

ment from its first position, and cautioning the man to fix the sight to the staff at the point directed, he may proceed forty or fifty yards farther; and after having again adjusted the level, make a sign to him to move to higher or lower ground, till the sight on the staff again coincide with the cross hair in the telescope. He may then leave a peg at the place where he held the staff, and proceed in like manner to other stations, till the whole line is finished, leaving pegs, or making pits, at the places where the staff was held.

If the length of the line to be levelled requires the instrument to be shifted from its first position, the level must again be taken from the last station where the staff was held, and the sight on it fixed in the proper place, as before directed, proceeding in the same manner at every forty or fifty yards, till the whole is accomplished. After the line is thus levelled, and ascertained by marks left at every station where the staff was fixed, it may again be examined, and other pegs put in between those first placed, the better to direct the workmen in cutting the drain; giving the line such alteration from the course of the level, as may shorten or straighten it, according to the nature and situation of the ground.

For the sake of accuracy, where the work requires it, especially if the water is to be conveyed a considerable distance, or wanted to supply a house, or for the purpose of irrigation, the levels may be proved by reversing the former line of direction. The spirit-level is also useful for ascertaining how much fall can be obtained from the drain to the nearest outlet where the water can be discharged; the shorter that distance is, the better, provided fall enough can be got.

It is often necessary to level a much longer distnce than the length of the drain may require to be cut; but when the level of the whole line is known. and the nature of the ground carefully examined, a shorter line of drain may effect the purpose; as will be judged of by circumstances that may be discovered in the course of cutting.

There is a triangular wooden instrument, in form of a mason's plumb, called the American level, which has been used in ascertaining lines on the surface, for the purpose of conducting drains or water-courses on a level; but as it has never been used in this country, and is very inferior in point of accuracy to the spirit-level, it deserves no particular description. When the line or lines of a drain are marked out in the field, it is useful to make a sketch of both, with the dimensions and levels marked at the various points, the better to preserve their exact direction, in case of their not being executed immediately; or the superintendence of their execution left to a different person than the one who marked them out. This is also useful in finding the lines afterwards, when it may be necessary to ascertain them.

PART III.

SECTION I.

Of the various modes of forming and filling drains, and their duration.

There is only one effectual mode of forming and filling drains, intended for the purpose of cutting off and conducting springs, and that has already been described. The depth, in that case, depends on that at which the stratum containing the water lies; the width at top must be in proportion to that depth; and the width at bottom must conform to the size of the conduit that is requisite, which is regulated by the quantity of water it has to convey. In short, the size of a drain, in point of width, should be no more than to give room for the men to work, unless when the soil is so soft and loose, that a greater slope is necessary, to prevent its closing or coming together; for an over width only increases the expense of digging, and also the quantity of materials used in filling, which is in many situations an object of economical consideration. Stone and brick are the most durable materials, where they can be had at a reasonable expense; but other substitutes have been found to answer well, where neither of the former can be easily procured. Stones are used in three ways: forming a square conduit; coupled, or set on end, so as to form a triangular opening; or thrown in promiscuously, which should never be done, if stones large enough can be got for boxing, or coupling below. The common brick, or those made on purpose, are perhaps preferable to stone, in respect that they can be more quickly and uniformly laid, and give less interruption to water than the ragged edges of stone. Whether stone or brick is used in forming the box or conduit, there should always be as many small stones above the cover as to close the interstices before the turf is laid on, and the other stuff is thrown in, part of which might otherwise find its way into the watercourse, and injure or choke it up. Wood, particularly old thorns, is next best to these, and when cut into billets, and laid in the manner represented in the plate, is found to answer remarkably well, particularly in soft or peaty soils, where the weight and pressure of stones would be apt to make them sink.

In clay soils, where the sides are solid, and not apt to crumble down, and where the quantity of water may be small, straw, loose or twisted into ropes, has been used. It leaves a sufficient opening for the water to flow through, and when the straw decays, the clay has formed an arch over it, capable of supporting the incumbent soil, and leaving a clear passage for the water below. But to resist the pressure of horses or cattle, in the act of ploughing, the depth must be sufficient to allow a proper quantity of earth above. The effect of every perishable material depends on this, and therefore the depth should be accordingly. Heath, furze, or broom, may be employed for the same purpose; and in all these cases, the bottom may be very narrow (not exceeding a foot), which greatly lessens the expense of digging, and saves both material and labor in filling.

The sod or pipe drains are undoubtedly the least expensive of any, and may be of considerable benefit in some soils, particularly in pastures; but their duration, and safety in tillage grounds, cannot be much depended on, unless, as in the last-mentioned cases, the opening is at a considerable distance from the surface, and when the mould that covers it becomes incrusted over the sod. The method of executing them is, by digging a trench of a proper width, and of a depth not less than three feet; and then, taking out the last portion with the narrow under-draining spade, a shoulder is left on each side, upon which a sod

or turf is laid, grass-side downwards, and the mould thrown in over it. These drains may continue hollow, and discharge well, for many years.

Another simple mode of making pipe-drains has been successfully attempted; but it is better culculated for the purpose of an aqueduct or conveyance for the water, than for drying the soil. A drain is dug to the necessary depth, as narrow as possible at bottom; in which is laid a smooth tree, or cylindrical piece of wood, ten or twelve feet long, six inches diameter at the one end, and five inches at the other, having a ring or rope fastened to the thickest end. After strewing a little sand at the bottom, and on the upper side of the tree, the clay, or toughest part of the stuff thrown out of the trench, is first laid in upon it, and then the remainder, which is firmly trod down. By means of the ring or rope, the tree is drawn out to within a foot or two of the small or hinder end, and the same operation repeated. This is no doubt a simple and ingenious experiment; and a gentleman who has tried it, says, "this clay-pipe has conducted a small rill of water, a considerable way under ground, for more than twenty years, without any sign of failing."

Another simple method to save meterials in grass-land has been practised. When the line of drain is marked out, a sod (turf) is cut in form of a wedge, the upper or grass side being the narrowest, which is done by sloping the spade in cutting or forming the sides. The sods are taken up in lengths of one foot or eighteen inches, and carefully laid on one side of the drain. After this, the drain is cut to depth required, by using the draining spades and scoop (that are shewn in the plate) which contracts it to a very narrow bottom. The sods are then set in with the grass side undermost, and pressed down as far as they will go, where they become fixed, like key-stones of an arch, resting upon the sloping sides of the drain. As they cannot by this means go to the bottom, a cavity is left underneath, to serve as a watercourse; and the space above is filled to the top with the earth thrown out. If the drain is three feet deep, (and it should not be less,) there will be two feet of earth above the sods, a depth sufficient to secure them from any injury by the feet of cattle.

On lawns, or smooth sheep pastures, a very simple mode of carrying off surface water, with a strong common plough, may be effected in this manner. After turning up furrows as deep as possible, through the hollow parts of the field where water is apt to stagnate, pare off the loose soil with a spade, leaving the inverted sod or grassy side about three inches thick; this done, turn over the sod into the furrow, grass-side up, as before. By this means a canal, or opening of three or four inches, is left in the bottom of the furrow, sufficient to discharge a considerable quantity of water, which will readily get into it. A great deal of ground may soon be gone over in this way; and when the furrows choke, or grow up, the operation can be repeated at a little expense. The earth pared up from the turned-up furrow may be spread on the surface or removed into a hollow.

Such are the various methods of forming and filling drains that have hitherto been most generally practised: there are certain deviations, however, which, being more owing to the whim and conceit of individuals, than productive of any real advantage, are unworthy of notice.

As to the season of the year for executing drains, it depends on the nature and extent of the work to be done. Summer and autumn are the most proper; for then the ground is drier, and free from that poaching and surface wetness, which renders the labor more tedious and difficult, if done in winter or spring. The materials to be carted for filling, also, are more troublesome to collect, and dangerous to be led, at these seasons, than in summer or autumn, when more work can likewise be done in course of the day.

Opening the earth in a dry season gives a tendency to drain it, as the particles of the soil, after being separated and dried when thrown out, will not so easily unite again; whereas the kneading and plastering which unavoidably takes place in winter, tends to prevent the flowing of the water, from those minute and imperceptible veins and interstices of the soil, through which it percolates.

When the land is in grass, or in summer fallow, their line of direction can with more certainty be traced. and the execution, in other respects, more perfectly accomplished.

In grass, turf can be got for laying above the stones, in place of straw, or leading it from a distance, which is no small saving; and, in summer-fallow, the distinctions between the wet and the and dry soil is easily perceptible, and any prominent inequalities of surface may then be easily levelled or reduced, by paring off the heights and adding to the hollows. Stones may likewise be more easily found in the fields at that time for filling. When a small spot is to be drained, or a single cut made in a field, it may be done at any time when the crop is not upon the ground. Bogs or very wet marshes can *only* be done in summer.

The duration of drains in general depends, as has already been mentioned, upon the nature of the materials with which they are filled. Stone drains last till accidental causes impede the flowing of the water; and when these do not happen, may endure for ever. Where perishable materials are employed, such as brick, wood, straw, &c., their endurance depends in some measure on the quality of the soil, as certain species of land have the power of preserving wood, and other vegetable substances, much longer than others; hence in moss, trees have been found almost entire, that must have lain several hundred years; whish shows that wood is particularly adapted for filling drains in such soils.

It may be added, that in every kind of drain to be covered, whatever the materials may be, it is necessary to have them filled with all possible speed, that the sides may receive no injury from the influence of the weather, which, by loosening the earth and making it fall down, causes a second operation of scouring and clearing necessary, before the stones or other materials can be laid.

The annexed plate (**No. XIX.**) exhibits, at one view, the various modes of filling drains with stone, wood, straw, &c., and will serve to elucidate these remarks.

SECTION II.

Of the general expense of draining, and of forming contracts for its execution.

The expense of opening and forming drains, according to the soil, depth, price of labor, materials

for filling, and other circumstances, vary so much in different counties, and even in the different districts or parishes of the same county, that no stated rule can be laid down for ascertaining it with a proper degree of accuracy. It is, however, sufficiently evident, that in every situation, when judiciously laid out, it never fails to yield an ample return for the labor and expense bestowed upon the work. The cheapest and most expeditious method of getting all work executed, is by contract. Draining, when on an extensive scale, should therefore be contracted for by the piece, *i. e.* either by lineal or solid measure, according to the nature of the work. Open drains of a large size, and of an ascertained width and depth, may be all agreed for by the cubic yard; but those that are narrow, and are to be covered, should be done by the yard, or rood (six yards) in length.

However explicitly the dimensions of drains are described by a plan, or occasionally to the workmen employed, they are so apt to go wrong, that the surest and most simple way is, to have a frame of wood of the exact size of the drain for them to work by. By this means it is impossible to err. In forming an agreement for the execution of drains that are to be covered, more caution is necessary than in the case of open drains. The digging to the specified depth, should be one part of the contract; laying the conduit and upper stones that may be necessary, a second part of it; and the filling in the earth at top, another. This is essential, for the purpose of seeing that the proper width and depth is adhered to, before the stones are laid; and, in the second place, that the conduit is properly formed, and the quantity of stones necessary put above it, before the earth is filled in. Workmen are in general so careless in these operations, where they are not interested in the success or effect, that they are very ready to execute them in a slight and superficial manner, and to lessen the dimensions that are given them. In all extensive undertakings of this kind, it is proper to have an intelligent person to superintend the work of the contractor.

As the prices of labor vary in different districts, and as the nature of the soil, and supply of materials for filling, are not alike in all situations, the expense of draining must vary considerably, according to these circumstances. Open drains do not exceed twopence per cubic yard, when the depth is between four and six feet, and may advance a penny per yard for every additional foot of depth. Drains to be covered, of six feet deep, may be executed at sixpence per yard in length; the stones laid, and earth filled in above, for sixpence per yard; and, in most cases, the stones may be quarried, or collected, and led, for sixpence per yard, making the whole expense one shilling and sixpence per lineal yard. These prices will, however, be less or more, according to the depth; but nearly in the above proportion, which, when any variation takes place, can easily be calculated. In short, the expense of draining in any situation, does seldom exceed the rate of £10 per acre; and as this seldom gives a less return than £10 per cent. or in many instances double that sum, certainly no outlay of money can be employed to better purpose.

Regarding the subject of these two last sections, additional information will be found in Part IV.

SECTION III.

Obstacles to draining, and means of removing them.

Improvement in every art is of slow introduction. At first, the success of the scheme is uncertain, till, by time and frequent experiment, the whole circumstances of the operation become familiar, and a facility of execution is acquired. Till then, many attempts will prove abortive; disappointments will ensue, and a certain expense will be incurred. This holds in agriculture, as well as in other arts. Improvements in farming must begin with proprietors, to whom a miscarriage is of less importance. That a farmer should express a diffidence in an experiment that is new, and which he fears is beyond his reach, is not to be wondered at; nor is he on that account to be blamed, as ignorant or obstinate. Experiments, the success of which are often precarious, are not to be risked by one whose living depends alone on his own industry. In those matters in which British farmers have a concern, their sense and sagacity lead them to pay attention to their interest; and when practices are recommended to them, by repeated success—and when they are convinced, either from their own observation, or from unquestionable authority, that the execution is practicable, and the expense within their reach—diffidence gives way, and industry undertakes and accomplishes, what reason and interest recommend.

Such now is the character of a great proportion of the farmers in Scotland; and neither ignorance, prejudice, nor obstinacy, is now, on their part, a bar to improvement. The landlords, in general, are liberal, and encourage an active and enterprising spirit among their tenantry; and by this means, improvement, in all the branches of modern husbandry, is coming every day nearer to perfection.

Notwithstanding of this being now in general the case, there are still a great many exceptions, more especially where short or uncertain leases exist, which certainly are a great drawback, not only to draining, but to every other improvement, of which many farms are capable.

It is the hope of reward alone that calls forth industry, and is the spring of all exertion. What object can a tenant have to hazard his capital, or devote his time and attention to the improvement of a farm, which he holds on a short or uncertain tenure? In every such situation, he must be restrained from any spirited expenditure, however much he may be satisfied, that the improvements that might thereby be effected, would, under favorable circumstances, be beneficial both to himself and to his landlord.

The smallness of farms, and consequently the want of spirit and capital among such tenants, is also another obstacle to this improvement; as such land must always remain under very imperfect systems of management. By these checks to agricultural improvement, the public is consequently deprived of the various advantages, which they might otherwise derive, from increased industry, and the augmentation of produce. As the removal of these obstacles rests entirely with the proprietors on whose estates they exist, it is hoped, that when such leases expire, a better system will be adopted, for the mutual advantage of both landlord and tenant.

There are several local impediments, which cannot be so easily got the better of. The want of stone, in many situations, is complained of; and the want of levels through contiguous property, is sometimes an obstacle severely felt. The first may, in a great measure, be remedied, by removing the tax upon brick,* *when used solely for that purpose*, and by using wood, as has already been described; and the latter may be obviated, by making an exchange of property in some cases, and by mutual agreement in others.

It has been hinted in the Introduction, that the drainage of the large tracts of moss that exist in Scotland, would be so beneficial an improvement to the kingdom at large, that it would be a measure deserving the attention of the legislature. Besides applying particularly to these extensive mosses and waste grounds, an act of parliament for the general encouragement of draining would be one of the most important and useful measures that could be introduced into this country. There are laws for dividing run-rig lands and commons; for straighting marches, and for erecting mutual fences: but there is none, by which we can compel our neighbors to join in a common drain, however advantageous such might be, for all the parties concerned. A great deal of wet land might be drained, and consequently brought into cultivation, if an act could be obtained upon the following principles:

1st, That every person should have a power to make his land dry, and to preserve it so.

2dly, That the expense should be defrayed mutually by those receiving advantage from the drain, in their due proportions, as ascertained by arbitrators and commissioners nominated for that purpose.

3dly, Full compensation should be allowed to those whose property may be injured, or who may grant a level for draining the lands of others.

4thly, That the method of obtaining this law, and the means of putting it in execution, should be so favorable, as to come within the reach of every one having even the smallest quantity of such ground to drain. And,

Lastly, That according to the proportion of expense, which each individual is found to pay, for the original construction of the drain, they should be bound to contribute in upholding it, or, when it is necessary, to renew or repair it.

For these purposes, the mode of procedure might be similar to that established for the settling of marches, &c.; and if the persons concerned could not agree to have the matter adjusted by arbitration, they might apply to the sheriff; or, if found necessary, go to the Court of Session, who would decide, as they do in the case of commons, by sending commissioners to the ground to settle it.

In England, the beneficial effects of a similar law have been frequently experienced. A *Commission of Sewers* is appointed, with power to carry into effect public drainages, where the interference of inactive or invidious proprietors would have otherwise put a stop to the operation. Though public advantage does thus interfere with private property, and though every man is entitled to the enjoyment of his own in the way he thinks best, there is no other measure by which this object can be so generally accomplished, where amicable or conciliatory means fail in bringing it to a conclusion.

In the present state of the country, when all its agricultural produce is unequal to the consumption of its population, and when this produce might be so much increased, by the division, the drainage, and the cultivation of its waste land, it is now the time for the Highland and Agricultural Society of Scotland, those of a similar description in England, and all other public spirited bodies, to exert their influence in bringing about this national and important measure.

Such are the chief obstacles which have hitherto, and do still, retard the progress of draining. There may be others of less moment, which have their influence in that respect; but these are in general less prejudicial in their tendency, and more limited in their operation.

* The duty is now taken off.

EXTRACTS FROM SOME OF THE 'AGRICULTURAL REPORTS' OF THOSE COUNTIES IN ENGLAND, WHERE MR. ELKINGTON EXECUTED THE MOST REMARKABLE DRAINAGES, AS PROOF OF THE ADVANTAGES DERIVED FROM HIS PRACTICE.*

Being Mr. Elkington's native county, and the one in which he first made the discovery, it is proper to begin with the 'Report' of

The County of Warwick, by John Wedge.

"Draining is, without doubt, the first step towards the improvement of all wet land; it has been practised with much success in this county for several years, but more particularly so since Mr. Elkington, a farmer in this district, introduced a method of draining boggy lands, by making *deep* drains, and *boring* at the bottom or sides of them through the different under-strata, so as to *tap* the springs, and thereby, in many instances, cure large tracts of land with very few drains. The novelty of this practice here, and Mr. Elkington's mysterious manner, in declaring he knew where, and in what direction, the different strata of the earth divided, and at what particular point an auger hole might be bored, to lay dry this or that particular spring or well, were matters which attracted much notice, and occasioned great surprise; and it is but justice to Mr. Elkington to say, that in one class of bogs, &c. which abound as much as (perhaps more than) any other, he has not only had the honor of introducing the auger in this county, but the merit of laying effectually dry, many large tracts of land."

County of Leicester, by John Monk.

"The most capital improvements have been made under the direction of Mr. Elkington, who is supposed to be the first in that line in the world. After forming the drain by beginning at the fall, and working upwards, he makes use of a borer to find the spring, with which he generally succeeds, which has a wonderful effect in draining the land. It is said that he has a very quick and certain me-

* These Extracts are taken from the first Reports transmitted to the Board of Agriculture; but in the second publication of them, the information on this subject is more full.

thod of finding where the springs lie, peculiar to himself. By the use of the borer, Mr. Astley* had a piece of land drained without going into it, by the following circumstance: Mr. Elkington was employed in draining a piece of land belonging to Mr. Richard Astley, which was separated from his brother's by a small river, or deep rivulet. Mr. E. finding the spring at about sixteen feet from the surface, (under the bed of the river,) completely drained both pieces. I was informed, that some time since, Mr. Elkington was engaged in draining a piece of land near Lutterworth; and soon after he had found (some call it tapping) the spring, the inhabitants, to their very great surprise, found their wells all dry! After investigating the cause, it was found that Mr. E. had been the means of it, by drawing off the spring which supplied the town with water.

"I mention the above two instances, merely to show what a wonderful effect the borer has, and what a very capital instrument it is for draining, &c.

"I do not mean to say that Mr. E. is the only person that makes use of the borer; for there is such a very great spirit for this kind of improvement, that there are very few of the best farmers without this instrument. Mr. Elkington has so much business, that it is with great difficulty he is to be had when wanted."

County of Derby, by Thomas Brown.

"———— But every other method seems to bend to that practised by Mr. Elkington, whose practice is becoming every day more extensive, and seems to me the most effectual of all others for carrying off subterraneous waters. He lays a stone drain, from three to six feet below the surface, in such a direction as to cut the source of the spring, and with such a declivity as to scour itself. Wherever he finds the source of the spring below the level of his drain, he bores, and with such judgment, that, to a stranger, his auger seems possessed of the virtue of that rod with which Moses struck the rock; for the water immediately gushes out, and perhaps lays land, that before was too wet to carry a sheep, sufficiently dry to carry the heaviest ox. This method certainly is effectual against springs."

County of Suffolk, by Arthur Young, Esq. Secretary to the Board of Agriculture, &c. &c.

"It will not be improper to hint, that there are two errors very common in the performance of this improvement. The first is, making the drains in, or nearly in, the direction of the declivity; whereas they ought always to be made obliquely across it: the other is, that of marking out, and making numerous drains across the sides of springy hills, which might, in many cases, be drained completely with a single drain, judiciously disposed, according to those obvious principles upon which the celebrated drainer, Mr. Elkington of Warwickshire, proceeds. No improvement can have greater or more immediate effects than this of draining; none that pays the farmer with more certainty."

County of Stafford, by William Pitt.

Mr. Pitt, in speaking of the improvements in Fisherwick Park says,—"Here the genius of a Brown, aided and seconded by the munificence of the noble owner,* have conspired to render a dreary morass one of the most delightful spots in nature, and have in a great measure succeeded; which success is still further heightening by the improvements of Mr. Elkington, in the interception of springs, and the discharging of stagnant water."

County of Worcester, by W. J. Pomeroy.

"In speaking of under-drains, it may be thought right to mention, that various experiments have been made at Ewell Grange, the seat of the Earl of Plymouth, and in that neighborhood; but that by boring after Mr. Elkington's method, deserves to be most particularly noticed, which, indeed, in such situations (viz. low, fenny, or boggy lands), seems to supersede the use of every other."

County of Somerset, by John Billingsley esq.

"The great skill of draining land consists in cutting off the water at its source. One deep drain, judiciously placed, will frequently preclude the necessity of any other; in most instances, such a drain should be near that part of the declivity from which the springs issue. This depends on the position of the clayey substratum, and on the height of the reservoir from whence the springs are fed. A judicious survey of the adjacent land, and liberal use of the *borer*, are necessary preliminaries to a cheap and effectual remedy for wet lands; and there are few men in the kingdom possessed of equal skill in this department of agriculture with Mr. Elkington of Warwickshire, whose fame is not confined to the county in which he lives, but is known and acknowledged in many parts of the kingdom."

Extracts from the 'Annals of Agriculture,' by A. Young, esq. &c.

"Aug. 5.—Rode to examine some works carrying on under the direction of Mr. Elkington, a singularly able drainer, whom I shall have more occasions than one to mention."———"The chief object of our ride was to view Mr. Elkington's works, who, we were informed, was engaged by some of the owners of these mills,† to bring them more water, by draining some boggy spots from which the springs arise. We viewed his trenches for this purpose: it seems that this most ingenious operator had contracted with the millers, to be paid only in proportion to the additional quantity of water he procured for them. As we viewed his drains, and the general declivities of the wastes around, a question arose amongst us, upon the possibility of procuring more water by any drains, or cuts, or boring, than flows already in a more diffusive manner through bogs; except by bringing water to take a direction on one side of a hill, which in its natural course, flows out on another side."——"But Mr. Elkington's practice is remarkable in one circumstance, *and differs from any drainer I have yet known.* From distance to distance at the bottom of his surfs,‡ which are of

*Of Odstone-Hall.

*Marquis of Donnegall.

† Near Sutton Colfield, in Staffordshire.

‡ Or sough, the conduit, or bottom part of the drain, formed with brick or stones.

various depths, from three and four to six and seven feet, he bores with a common iron boring rod, five or ten lower, and in doing this, often finds the water rise quickly in the hole. By this operation, it should seem, that he has Mr. Bakewell's idea in contemplation; and it is to be noted, that by this practice, he, in many cases, by a single drain, lays lands dry that were not at all in the contemplation of the person who employs him, even to a considerable distance. Supposing springs to lie in strata nearly on a level, and to communicate from side to side of the largest hills, in such case it does not seem at all improbable but that, by draining and boring deeply on one side, you may procure more water than came before, by diverting it from the usual course; so that, by carrying on works of this sort on one side of a mountain, the other side, at some miles distance, may be drained. Thus the millers on one side of a hill may pay Mr. Elkington for bringing water to their dams, and the millers on the other side of the hill prosecute him for depriving them of theirs; which, it must be confessed, would be a laughable litigation."*——"Such works, whatever their operation, causes and consequences, have infinite merit, and do great credit to the talent of this very ingenious and useful man, who will have the merit wherever he goes, of setting men to think."

"The 6th.—To Ashby-de-la-Zouch; called in our way on Mr. Marshall, to view a bog drained by Mr. Elkington, which he effected with his usual success.

"This bog was occasioned, as they commonly, or rather always are, by springs, which he pierced into by means of a deep drain, boring at the bottom of it, as above described; the surf, in this dry season, runs no inconsiderable stream. The whole is now under oats, a very fine crop, on land which before was of no value whatever."——"Mr. Elkington has been employed by Mr. Knowles† to drain the slope of a hill poisoned with springs; in every instance of his draining, I hear some new circumstance to prove the sagacity and ingenuity of this skilful operator, who may be termed an engineer of a new order. The crown of the hill above Mr. Knowles' wet fields is all dry, sound, gravelly land, in which there are no signs of springs, because pervious to water in its level; but when these springs came to the fields in question, which are clayey, they rise to the surface, proportionably to the quantity of clay which impedes their progress. In this case he found, by taking the levels, that springs on the other side of the hill, in a clayey spot, at the distance of some hundred yards, were exactly on the same level as these passing under the gravel on the elevation, and thus breaking out where the passage was obstructed by variation of soil. And he pronounced, that when this is the case, one surf, skilfully marked, will drain a variety of different, and even far distant fields; and he recommends, in such cases, to wait, after the first drain is made, to let its operation take place for six months, or even a twelvemonth; in which time it will be found how far the effect has taken place: if more are wanted they can then be made. When springs are brought in this manner from a distance, there is no doubt but he brings more water to a place than flowed in it before. The great skill is to know where to bore."

In a treatise lately published, "On the necessity and advantages of care and economy in collecting and preserving different substances for manure," by Thomas B. Bayley, F. R. S. is the following observation:—

"It may reasonably be expected, that at no very distant period, the peat-mosses of Great Britain and Ireland will be drained, and brought to the highest state of fertility. Their present superabundant moisture renders them not *merely* unproductive wastes, but extremely injurious to the drier lands in their vicinity. The invention and energy of a Wakefield* and an Elkington, in reclaiming and improving mosses, cannot fail to excite a general imitation of the very successful processes by which they have rendered these bogs productive of plenty; with the additional happy effects which those improvements never fail to produce on the *climate*, *temperature*, and *vegetation* of all the countries adjacent to them."

Thomas Eccleston, esq. of Scarisbrick-Hall, Lancashire, in a communication to the Board of Agriculture, states, "In a valley belonging to me, covered *fourteen feet* thick with clay and clay-marl, the surface in many places was perfectly boggy, and so soft as no horse or man could walk upon it. Mr. Elkington ordered *one* straight drain to be cut in the *lowest* part, at least *five* feet deep, and then to *bore* through the marl or clay, which *effectually* drained *sixty* statute acres; and *one field*, that before was worth very little rent, I let, after the drainage, at *forty* shillings the acre. The expense did not exceed *fifty* pounds in the whole, and the *old* tenants give *thirty* pounds per annum more rent than before."

Letter from Thomas Paget, esq. of Leicestershire, to Sir John Sinclair, Bart. President of the Board of Agriculture, respecting Mr. Elkington's mode of draining.

"*Sir*—Having understood by Mr. Elkington, that the board of agriculture intended doing something in his favor, by way of reward and encouragement for his services to the public, by the introduction of his method of draining bogs and wet land; and having the highest opinion of his merit and judgment, from repeated experience, and desirous of bearing my testimony thereto, I take the liberty of troubling you to say, that after having made draining of land my study and practice for more than thirty years, I found, upon having Mr. Elkington's assistance, the lands which I had drained might, by his method, have been more effectually drained, and with a great deal less labor and expense.

"The extent of the improvement, and the expense of the work, is various, as must be obvious

* Such a case occurred on Lord Dundas's estate in Yorkshire, where the author of this treatise was employed at the time. It gave rise to a lawsuit before the court of assize at York, immediately after the operation took place, at a considerable cost to both parties.

† Of Nelson, in Leicestershire. In a certificate sent to the Board of Agriculture, Mr. Knowles says, that this land, by means of Mr. Elkington's drains, was rendered worth 30*s*. or 40*s*. an acre, which before was not worth half a crown.

† Of Liverpool. Mr. Wakefield has made wonderful improvements upon the great Trafford moss, near Manchester, in Lancashire.

to every one, and depends upon the nature of the land, the situation, and many other circumstances. In many cases, particularly in bogs, great and extensive improvements are frequently derived from Mr. Elkington's method, at a small expense; and in all cases where I have had his assistance, or when he has been employed by others, as far as I have had opportunity of observing (and which has been pretty frequent), I have always found he has succeeded to my fullest expectation, and to the satisfaction, and frequently to the surprise, of his employers.

"On this ground I take the liberty of recommending Mr. Elkington to the countenance and encouragement of the Board of Agriculture, as one from whose study and labor I apprehend this country is likely to receive the most valuable advantages; being fully convinced, that if the draining of land was reduced into a regular system, and carried into general practice, (which I hope, with Mr. Elkington's assistance, it may), the improvement resulting therefrom to the lands in this kingdom would be of the highest importance. With the highest respect, I am, sir, your obedient humble servant,

(Signed) T. PAGET.

"*Scraptoft, near Leicester, May* 30, 1785."

Subjoined is part of a letter received by the author, of Charles Townley, Esq. of Townley, in Lancashire, respecting Mr. Elkington's method of draining, and the improvements made by means of his drains:—

——"Respecting the mode of executing these drains, it differs from the common practice of making hollow drains, by their being cut much deeper, and by boring with an auger, either to increase the ruins of water from the springs, when they are arrived at, or to give them vent when they lie too deep for the spade to reach them. Mr. Elkington's art, or knowledge of draining, lies, as you must know, in judging of the precise place where the springs can be caught, and in carrying them off in the cheapest and most advantageous manner. The mere plan of a drain can give little insight into this kind of knowledge. I should think, the best mode of conveying the system, by plans, to the conceptions of others, would be to compose sections of the different circumstances that most generally occur in the various strata and runs of water below the surface of the earth, and of the most proper situations for the drains that are to catch them. I will only repeat, that those drained *boggy lands* that have had the proper manure laid upon them, are not only made dry, but the herbage produced on them is become excellent, from having been, previous to the drainage, of very little value; and those drained lands which have as yet received no manure, are rendered equally dry, and the coarse and useless herbage with which they were wholly covered, is visibly giving way to better grass. The proper manure will soon be laid on them; after which, I am persuaded, the whole herbage will be excellent. The drains were only finished last year.

(Signed) CHAS. TOWNLEY.

"*Townley, 28th Sept.* 1796."

Copy of a Letter and Certificate from Mr. Maughan to Sir John Sinclair, Baronet.

Hinckley, 25th Oct. 1796.

"SIR:—I am extremely sorry at having taken so long a time in returning the certificate you wished me to send; but I waited to see the effect of a drain I had set out for Mr. Jennings of Harlington, Bedfordshire, a nephew of the late Whitebread's, or I should have sent it sooner. The land I drained for him had, about two years ago, been attempted to be drained in the common mode, and a considerable sum of money had thereby been expended to no purpose, as the land, at the time I undertook to drain it, was as wet as ever. I have the satisfaction of saying it is now the driest land on the estate, and made so at an expense which does not exceed one twentieth part of what it had formerly cost, by attempting the common mode of draining.—I am, sir, your obedient humble servant.

(Signed)

"JOHN MAUGHAN."

Copy of the certificate.

"I, John Maughan of Luton, in the county of Bedford, land-surveyor, late steward to Thomas Powys, Esq. M. P., do hereby certify, that, in consequence of a recommendation from the Board of Agriculture, I waited on Mr. Elkington, who very readily communicated to me the principles of his art of draining land, which I have since practised myself with great success, and to the satisfaction of those who have employed me. And I hereby farther certify, that I have found Mr. Elkington's mode of draining of the greatest public utility; that I have seen land of little or no value, when drained on Mr. Elkington's principles, made worth forty or fifty shillings per acre, and producing the richest crops, both of corn and grass. In short, that no mode of improving wet land equals it, for public utility. Witness my hand, this 25th day of October 1796."

Besides the above, many other communications and certificates, testifying the great advantages that have been derived from Mr. Elkington's practice, and what are likely to result from the knowledge of his system being generally understood, might have been added; but as most of these have already been made public by the Board of Agriculture, in a former report on that subject, what are inserted here may be sufficient to convince the public of its utility.

PART IV.

ON HOLLOW AND SURFACE DRAINING IN GENERAL, AS MORE PARTICULARLY PRACTISED IN THE SOUTHERN AND EASTERN COUNTIES OF ENGLAND.*

Though this be a part of the draining system not coming within the limits of Mr. Elkington's practice, and founded on principles different from those that are applicable to the drainage of bogs, and other swampy ground injured by springs, it is, however, much practised in the south of England, and even in some parts of Scotland; and may therefore be a useful addition to this Treatise. When the wetness of a field is caused by rain water that cannot sink through a tenacious soil, and must (if there be no declivity) remain till

* Partly drawn up from the author's own observations, and from memoranda communicated by the late Arthur Young, Esq. when Secretary to the Board of Agriculture.

evaporated, the principles which govern Mr. Elkington's system are not applicable. But in all cases, (and such are very numerous,) where the wetness proceeds alone from rain-water stagnating on a retentive surface, a farmer ought to examine his field carefully, in order to ascertain whether such wetness proceeds from *surface water only*; or if it arises from that of springs. If from the latter, he should endeavor to discover if such springs are distinct and unconnected; or whether they are supplied from *one main spring*, which, if cut off, would *effectually* drain all the land lying *below* its source; as has been fully explained and exemplified in Section 2d of Part II.

From want of due attention to this necessary discrimination, it is very common in Essex, Suffolk, and other counties where draining is very generally performed, to see many superfluous drains marked out in directions where they can have very little effect, and where a single one, well directed, would have completely dried the field. As the expense, which might thus be saved, is an object of consequence, too much attention cannot be paid to the inquiry.

1. *Of the antiquity of the practice of hollow-draining, and when first used in England.*

That the Romans were not unacquainted with the common methods of hollow-draining, appears from all their writers on rural affairs. Upon strong tenacious land, where the water could only be received at top, they preferred open drains; on other soils, where the water could be drawn equally from both sides, or could rise from the bottom, they used covered ones. They knew the propriety of directing them obliquely across the slope of the field,—a point in which modern drainers are often erroneous. Their general depth was from three to four feet, filled half way up with small stones; for want of these, with willow poles, and even with the spray of wood twisted into a rope; one of the latest practices with straw that has taken place in England. Of that material also, the Roman farmers availed themselves, when others were wanting. The ends of their drains they were careful in fortifying with larger stones, in form of bridges; and the mouths, or outlets, were laid in masonry—a circumstance in which Mr Whyn Baker, of Ireland, thought himself original.

From the depth, it appears that their drains were designed to carry off the water of springs, as well as that caused by rain on a flat or retentive surface soil; for both which they were, in some cases, equally well adapted.*

To the proper direction of the water-furrows, in order to convey all surface water into the drains, and to the clearing and cleaning out of the ditches round the fields, they paid particular attention. These circumstances are sufficient to prove that the Romans understood the business of common draining in great perfection, and that our best cultivated counties had little to boast of in this respect, in superiority to the ancients, till Mr. Elkington made the discovery of a method with which they were wholly unacquainted. The best of the French writers on Agriculture, De Serres, who wrote in 1600 his '*Theatre d'Agriculture*,' describes hollow drains particularly; they were filled with stones.

It would demand a very careful perusal of all the earlier writers on husbandry, to ascertain when this practice was first introduced; but a circumstance occurred in Sussex, which shows that hollow-draining was in use long before any mention would be found of it, were such authors consulted, as no notice of it occurs in Fitzherbert or Norden.* In 1770, Mr. Poole, of that county, informed a farming traveller, "that near one hundred years ago, a very large oak, two hundred years old, was cut down at Hook. In digging a ditch through the spot where the old stump was, on taking up the remains of it, a drain was discovered under it, filled with alder branches; and it is remarkable, that the alder was perfectly sound, the greenness of the bark was preserved, and even some leaves were sound. On taking them out, they presently dropped to powder. It is hence very evident, that under-ground draining was practised three hundred years ago in this kingdom. We find, also, that alder is, of all other wood, the best for filling drains. Probably no other, except aquatics, would endure nearly so long. Bushes are generally used, and sallow or willow is probably the best."†

The Board of Agriculture were informed by Richard Preston, Esq. one of its correspondents, in 1796, that land-draining, according to the present practice, was not of more than forty years' standing in Essex; though it is generally supposed to have been used there long before that period.

II. *Nature of the moisture, or wetness, against which they are chiefly used.*

Springs that proceed from water at any considerable depth in the earth, or which break out, from the variation of certain strata, in hills, which demand deep cutting, and the use of the auger, to work their cure, according to Elkington's mode of draining, has already been treated of. Hollow drains that come under the present description, are chiefly used to correct that wetness of soil which results from rain; and which, from flatness of surface, or its retentive quality, stagnates, to the injury of both soil and crops. This is the general nature of the evil which these drains are intended to remedy; but by no means exclusively of that caused by *land* springs, whose seat, apparently, is not below their depth. The wetness proceeding from such, is, in some cases, removed by these drains, when deep enough cut, and properly directed; but in many others, from ignorance in the drainer, great sums of money are thrown away, for want of attending properly to the nature of the evil, and of distinguishing betwixt *surface-water only*, and the oozing of *land-springs*.‡

III. *Of the soils on which they act, and of those on which they have been found to fail.*

In soils that are so tenacious as to retain water on the surface till evaporation carries it off, such as are found in Sussex, Surrey, and in many other

*The passages of the ancient writers on this subject are quoted and translated by Mr. Dickson, in his 'Husbandry of the Ancients.'

*Fitzherbert wrote his boak of Husbandry in 1534.

†Eastern Tour, vol. iii. p. 141.

‡Those which issue from between the upper soil and next stratum. Every heavy shower supplies them, and a few dry days exhale and exhaust them.

counties, this method of draining has been tried, and found entirely to fail. The cause of this can easily be accounted for. Very stiff clay will hold water *like a dish*, (the expression of the farmers in those counties, who have attempted to drain such soil;) and consequently the small portion of water which each drain will carry off, is only what falls immediately above it, or what it can receive at top, when the ground on each side has a descent towards it.

The water being all *on the surface*, cannot find its way into them. If they are on a declivity, the water will run over them, as it does over any other part of the field; and if they are in a hollow, it will stagnate even above them, and will be mostly exhaled before any quantity of it subsides into them. This is therefore a more expensive soil to drain, requiring a greater number of trenches, and these very close together, than any other soil whatever. Open trenches, with the ridges and water-furrows properly formed and directed, is the only method whereby its drainage can be effectually accomplished.

It is necessary to lay it up in ridges properly placed, and to cut *small open drains* across the ridges, where requisite, communicating with each other, and with the furrows: and thus all the water-furrows operate as drains. The water, as it falls upon the ridge, immediately makes its way into the furrows, and runs along them, while there is a descent; and if it is stopped in any of them, by the ground rising, it is conveyed by the drains across the ridges into some other furrow where there is a descent; along which, it makes its way into some ditch or water-course, at the extremity of the field.*

In Essex, and in Suffolk, where it has been found advantageous, the soil is a wet poachy loam, more or less mixed on the surface with vegetable mould; under that, in some places, a *raw hungry loam*, and in others a clay marl.

On these soils the effect is very great; for the upper stratum, where the moisture is chiefly lodged, being in some degree porous, the water is easily extracted from it, by means of the drains. The under stratum being also of a retentive quality, their depth does not require to be great.

When Mr. Young, of Clare, who has had great experience in this mode of hollow-draining, observes, that the improvement by these drains is great on clay soils, he certainly means soils of this description:—"I know from experience, that in clayey soils it will answer perfectly; that it is the least expensive and the most expeditious, as well as most durable improvement, of any in the whole system of agricultural economy."

IV. *By what rules their direction is marked.*

For many years, probably for more than half a century, and possibly during a much longer period, the farmers did not make a proper distinction in fields that had a declivity, between tracing their drains *with the slope*, or directing them *obliquely across it*. Large tracts have been drained, or have been meant to be drained, in the former way, and many, even to this day, are guilty of the same error; but the best farmers are now attentive to so important a point, and studiously mark the direction of their drains obliquely. They are also careful to give them just the fall sufficient to carry off the water in a gentle, and not a rapid current; by which means they are less apt to choke or *blow up*, (as it is semetimes called,) whereby spots in the field have, apparently, an artificial spring formed.

Upon fields level, or nearly so, great numbers of which are found in the eastern counties of England, it has been a common practice (although an expensive one) if the wetness proceeds solely from rain, to mark the drains regularly at a rod,* a rod and a half, or two rods asunder, across the land from ditch to ditch; or if the drains, from any small inequality of surface, will flow only at one end, then to stop short or discontinue their length on one side of the field, as soon as the ditch operates in laying it dry.

Where the slopes of a field vary, and fall in different directions, the farmer attends to such variations, and directs his drains so as to cross obliquely the upper side of each declivity.

It is a general rule, not to conduct too many drains to the same mouth or outlet; for if much water flows in any drain, from having thrown many lateral branches into one main drain, the latter must not only be made larger and deeper, but will even then be liable to fail; and a failure in that case affects so much a larger space of ground, by impeding the course of so many other drains. On this account, it has been found better to make the drains detached, rather than to connect too many of them together, which occasions too much water to be conducted to one mouth.

Cases will however occur, in which, from the position of the ground, it may be found necessary to join several side branches into one main drain. On this subject, Mr. Vancouver, in his 'Agricultural Report of Essex,' has the following judicious remark:

"If the field proposed to be drained lies greatly upon the descent, every care should be taken to make the drains bear sufficiently horizontally, in the first place, to prevent a too precipitate fall of the water, by which the bottoms of the drains would be worn uneven, and a temporary obstruction occasion them *to blow*, or burst up; and, secondly, because the more perfectly horizontal is the field, so that it lies level free, and affords a sufficient fall for the water, the less occasion will there be for the same number of drains as would be required upon a soil of equal closeness upon the side of a hill—the drains in a field that lies nearly level, drawing equally well upon each side; whereas those on the hang of a hill, drawing only from the higher sides of the drains, and consequently requiring them to be made much nearer or closer together."

V. *Season for executing the work.*

On this point, opinions vary; some preferring winter, and others summer.

When a great quantity of work is to be done, all seasons of the year, free from sharp frosts,

*It is obvious, that laying up such land in ridges, and cutting drains in proper places, may be of great use, but will not effectually remove the wetness; as the soil, from its nature, will always retain too great a proportion of moisture. It is necessary, therefore, to change the nature of such soil by frequent culture, and the application of manures, which will in a great degree lessen its tenacity, or power of retaining water.

*Sixteen and a half feet.

must be made use of; and this is usually the case when a farmer enters on a lease to a farm which has not been drained, or which requires to be done a second time. Stubbles are done in winter, and fallows in summer; but when a single field or two only are to be done, the farmer may choose the most convenient season. Many excellent farmers would not do it any other time than summer, from being then able to execute the cuts in a cleaner and neater manner, and free from that kneading and plastering which takes place in winter, and which, they think, tends to prevent the flowing of the water from those minute and imperceptible veins and interstices of the soil through which the water percolates. They have further remarked, that opening the earth in a dry season gives a tendency to drain it, as the particles of the soil, after being separated and well dried, will not so easily unite again; whereas the kneading in winter tends to increase tenacity where it is most to be avoided. Further, that carting on the fields in winter, to bring on stones or other materials, is more difficult and dangerous than in summer.

In opposition, however, to these ideas, Mr. Young, of Clare, in Suffolk, is of a contrary opinion.

"I never land-drain," says he, "in summer: two inconveniences attend it; the increase of labor in a clayey soil, when hard and dry, is very considerable, and the want of leisure, and when good laborers are scarce."

The want of laborers in some places may be an unanswerable objection, but the dryness is not; for if the previous furrows opened by the plough or last course of ploughing on arable land be not left to dry, but the spades follow directly, after a little rain, there will be moisture sufficient to make it work freely. Many good drainers prefer executing the work when the land is under *a layer*, i. e. sown down with grass. Lord Petre, on this, observes, that the plough for opening the previous furrows, works better on a layer.

"I prefer a lay, if layed down level, as I have a plough on a very simple construction, with which and six horses, I can plough from ten to twelve inches deep, and lay the furrows as regular as a man can with a spade; so that, after the ditch is digged and filled, the furrow can be put into its place again, and rolled with a large roller quite level; and then I dig but one *spit*, with the bottom land-ditching spade, fourteen inches deep—the expense 2*s*. 8*d*. per 20 rods, the digger returning the furrow to its place. I also use this plough on fallow; but it does not answer so well, as the moulds fall into the furrows. The expense of digging on fallow is 1*s*. 2*d*. per rod."

When the ground is in summer fallow, is certainly the best time for casting drains that are only for carrying off surface-water, as the distinction betwixt the wet and dry parts of the field is then easily perceptible; and any prominent inequalities of surface may then be more easily levelled or reduced, by paring off the heights and adding to the hollows.

VI. *Manner in which drains are partly opened by the plough.*

The method practised by Mr. James Young of Clare, which he has described himself, from very ample practice, is deserving of attention. He says—"When I have marked the drains in a field, (usually a rod asunder), I draw two furrows with a common foot-plough, leaving a *baulk* betwixt them about fifteen inches wide; then, with a strong double-breasted plough, made on purpose, I split that *baulk*, and leave a clean furrow fourteen or fifteen inches below the surface; but, where the depth of soil requires it, (for I like to touch the clay), by a second ploughing I sink it to eighteen or twenty inches; it is then ready for the land-ditching spade, with which I dig, fifteen inches deep, a drain as narrow as possible."

The method followed by some good farmers, who do not possess ploughs made on purpose for the work, is this: with their common plough, drawn by four or five horses, and usually stirring about four or five inches deep, they turn a double furrow, throwing the earth on each side, and leaving a *baulk* in the middle. This *baulk* they raise by a second *bout* in the same manner; then they go in the open furrow twice with their common double-breast plough, getting what depth they can; after this, they shovel out all the loose mould and inequalities, to the breadth of about a foot; and thus having gained a clear open furrow, the depth varying according to the soil and ploughs, but usually about eight or nine inches, they dig one *spit* with a draining spade, sixteen inches deep; thus gaining in the whole twenty-four or twenty-five inches. But, as this depth is seldom sufficient, when necessary they throw out another, or even two other *spits*, which make the whole depth from thirty to forty inches.

VII. *Depth and width.*

The depth is various, according to the nature of soil, the situation of the field, the expense the farmer is willing to incur, and to a diversity of other circumstances. Many years ago, three feet was the common depth in most soils; but for twenty years past, they have seldom exceeded thirty or thirty-two inches; and the number that are cut only twenty-four or twenty-six, is much more considerable.

Main or receiving drains are always a little deeper than the others, having more water to convey, and farther to carry it. The deeper they are dug in pervious soils, the farther they will operate in reducing the moisture to a level where it can less injure vegetation; but when the spade reaches an impervious soil, through which water will not percolate, there is no occasion for making the trench any deeper. A few inches, however, in the clay, as a safer channel for the water, is of advantage.

One general rule is never to be departed from, which is, that the depth must be sufficient to prevent the plough, or the impression of the feet of cattle, from affecting the position of the materials used in filling them. This must particularly be observed of horses walking in the furrow while ploughing, as they then tread four inches, and perhaps more, below the surface of the ground; add to these four inches, nine or ten more for the materials, and when the drains are only twenty-four deep, there will be nine or ten inches of soil to bear the weight of the horse in the act of ploughing. This, as the earth has been stirred, seems certainly too little; and should apparently ascertain that twenty-four inches is by no means a sufficient depth. If, by going thirty inches down, a tenacious soil is not too deeply entered, a greater depth in a more porous one is surely requisite, and ought to be preferred.

In all the modern drainages in the eastern counties, the farmers have been very solicitous to cut them as narrow as possible; by which means a great saving is made in the materials used for filling them, such as bushes, poles, spray, or straw; but if brick or stones are used, of course this rule cannot be adhered to. However, there is no occasion for the width being greater than one foot, if the stones are only coupled at bottom, or thrown in promiscuously, or more than sixteen inches if laid in the form of a conduit. Whatever the depth of the materials be, the mould that covers them to the surface should never be less than one foot thick, or rather more, in all tillage fields. In pasture land, gravel, if at hand (especially if the soil is very tenacious) is preferable to the mould thrown out, which may be spread in any adjoining hollow.

The depth and width, &c. marked in the plate, is the proportion that ought to be adopted on all land that is wet from surface water, or from its stagnation in a porous upper soil.

VIII. *Tools employed, and manner of digging.*

The instruments which have been long in common use in the eastern parts of the kingdom, are extremely simple.

While the depths of the drains were more considerable than at present, three spades were in use to succeed one another, lessening in breadth gradually, in such a manner as to form a regular contraction to the bottom; but of late years, cheaper and easier methods have been pursued. By previous ploughing, all the spades, except the lower one, have been laid aside; and where a greater depth than common has been required, not more than two have been used. The scoop, which is pushed or drawn along the bottom of the drain, to clear out the loose mould, and prepare it for the materials used in filling, varies, in size and breadth, according to the width of the drain. The draining spade, which is also of different sizes, is represented in the plate.

The preceding circumstances point out the manner in which these drains are, for the most part, dug; but there is a material difference in the truth and accuracy with which they are executed, according as a workman is accustomed to the business, and skilful or awkward in handling his tools. The work is almost universally done by measure, at so much a score rods, which, as in similar cases, induces the men to earn as much as possible. They requre, however, close attention, to see if they keep to the depth contracted for, and that they deposit the earth so as not to fall in, in the act of filling, especially as the surface soil should (on one side at least) be kept free from the clay or lower stratum.

In filling, more attention is necessary, if done by contract, which will be afterwards explained.

IX. *Opening drains by the plough only, &c.*

The Society for the 'Encouragement of Arts, Manufactures, and Commerce,' gave a bounty, about fifty years ago, to Mr. Makins of Suffolk, for having invented a plough to cut hollow drains.

There was merit in the idea, but it has long since been entirely laid aside, both in Suffolk and Essex.*

*In Bailey's "Advancement of the Arts," there is a plate, and explanation of it.

Another plough, to answer the same purpose, was invented by Mr. Arbuthnot of Mitcham, of which an account is given in the 'Eastern Tour,' with a plate and measurement of it. And lately, the Society of Arts have made several trials with a plough for the same purpose, called a *mole* plough, of a singular construction; the intention of which is, by considerable force, to draw a pointed circular iron, at a given depth, through the earth, which shall form a pipe in it—not to be filled with any materials, but in the expectation, as it is said from experience, that the water will flow freely through the soil it has loosened, to a depth below the roots of the grain, and will find its way by filtration into the furrows.

The repeated ploughings or shovellings with common tools are expensive, and might probably be executed in a cheaper and more expeditious manner by an open drain plough.

How far that invented by Mr. Knowles, and rewarded by the Society of Arts, would, at a sufficiently cheap rate answer this purpose, has not been sufficiently ascertained. But it is obvious that, from the force and number of horses or oxen requisite to work them, ploughs calculated for this purpose will never come into general use.*

Another invention for draining land, in Essex, is thus described in the 'Agricultural Report' of that county:—The author of this experiment has constructed, and uses a draining wheel of cast iron, that weighs about 4 cwt. It is 4 feet in diameter; the cutting edge, or extreme circumference of the wheel, is half an inch thick, which increases in thickness towards the nave or centre, and will, at 15 inches deep, cut a drain half an inch wide at the bottom, and four inches wide at the top. This wheel is so placed in a frame, that it may be loaded at pleasure, and be made to operate to a greater or less depth, according to the resistance made by the ground; which, thus cut in the winter, the wheel tracts are then either filled with straw ropes, and lightly covered over, or left to crack wider and deeper during the ensuing summer. The fissures are then filled with twisted straw or bushes, and covered lightly with some of the most porous earth that may be most conveniently at hand; and thus, upon the grass, or ley land, are hollow drains formed at little or no expense, and which, upon trial, have been found to answer extremely well."

This draining-wheel is also described in the 'Annals of Agricuture,' where it is said that twelve acres have been done with it in one day; but neither the expense of the machine, nor number of horses required to draw it, has been stated. It works or cuts best when the land is wet and soft.

X. *Materials with which they are filled.*

In respect to the materials for filling the drains, the farmer must be guided by circumstances of situation, &c. Those most commonly used are, 1. stone; 2, wood; 3. straw and stubble; 4. heath or ling; and 5. bricks made for the purpose.

If stone taken from quarries is to be used, and the drain formed like a conduit at bottom, the trench is made wide enough to contain two side stones, about six inches asunder, and the same in

*A Mole Plough has been constructed by Mr Wilson, an ingenious mechanic at Coldstream, in Berwickshire, and is likely to be of service in draining land that is entirely free of stones.

height, with a cap or flat stone laid over, which covers and secures the cavity through which the water passes. These drains are more expensive than when the stones are thrown in promiscuously, but are the only ones applicable to springs, which may be prevented from injuring large tracts of land by cuts comparatively short. But in Essex, and the other eastern counties, when hollow drains are filled with stones, it is usually with flints from chalk, or with stones from gravel pits, or gathered off the fields.

Very small stones do not answer well for any but very short drains, in which little water is conveyed; and if of any size, require a greater width at bottom than wood or straw, and consequently render the expense of cutting greater.

Whether the stones are large or small, they should be very clean, and free from any clay or earth that may adhere to them, and put in carefully, so as not to tumble down any of the earth of the drain, which might be apt to choke up the interstices betwixt them.

Upon the subject of filling drains with wood, Lord Petre thus expresses his opinion:—

"The drains filled with wood, and covered as usual with straw or rushes, are preferable to stones, or any other kind of materials. The reason is, as the wood decays, the water continues to pass.* When filled with stones, and the drains stop up, which must be expected to take place in time, the earth becomes quite solid round the stones, and as they do not decay, the filtering of the water is forever obstructed: not so when bushes or wood are used. Continual filtering and draining are then forever to be perceived; and by repeating the operation a second time, cutting the drains transversely of the old ones, the benefit of the filterings through the rotten wood is secured, and the spewing up of old broken and damaged drains corrected and carried off. Moreover, as bushes form a much greater number of cavities than either stones or poles, they are less liable to stop up, and encourage filtering more than larger and more solid bodies."——"A load of bushes, containing one hundred and twenty faggots, will do about three hundred and sixty rods; and a load of straw, containing one hundred and twenty bottles, the same; the load of bushes is generally worth about 14s. and the straw 18s. per load. I therefore calculate this expense about 12s. per acre, ditches a rod apart."

Richard Preston, esq. of Blackmore, a correspondent of the board, prefers, on twenty years' experience, black thorns to every other material for filling.

There is also another method of filling with wood, by suspending the faggots or bushes upon cross billets set on end in the bottom of the drain, as represented by No. 5 in the plate.

This kind of drain has been successfully practised in Berwickshire, where it is said to have continued running for thirty years.

It was also attempted at Livingston, at that time the seat of the late Sir W. Cunninghame, but was not approved of there; for it is said, that the feet of the cattle, in ploughing, went down and deranged the billets that supported the brushwood, and consequently put a stop to the discharge of the water; but this has been owing to the want of a sufficient depth of earth above the wood, which was not more than six inches.* This kind of drain is, however, much recommended by the writer of the 'Agricultural Report' of the county of Caermarthen, in Wales. He says —"The completest method I have yet known, is to cut the strongest willows, or other aquatic brushwood, into lengths of about twenty inches, and place them alternately in the drain, with one end against one side of the bottom, and the other leaning against the opposite side. Having placed the strong wood in this manner, I fill the space left between them on the upper side with the small brushwood; upon which a few rushes or straw being laid, as before mentioned, the work is done. Willow, alder, asp, or beech boughs, are exceedingly durable, if put into the drain green, or before the sap is dried; but if they are suffered to become dry, and then laid under ground, a rapid decay is the consequence. I have seen willow taken out of a bog after lying there thirty years, and its bark was as fresh and sappy as if it had been recently cut from the hedge; and it is well known, that beech laid green in the water will continue sound for any length of time."

There is another method preferable to these, and requiring less wood: it is, to fix in, at every foot distance, a stick, in manner of a hoop or semicircular arch; and along these to lay the longer poles or branches longitudinally. This will form a secure vacuity below, and an arch capable of supporting any weight of earth necessary above it. From its known durability in water, and being sufficiently pliant, the young branches or prunings of larch are well adapted for this purpose.

Mr. Majendie is of opinion, that wood of eighteen years' growth is much more durable than that which is ten or twelve.

Respecting filling drains with straw, the following observations by Mr. Vancouver, in his 'Report' of Essex husbandry, merits attention:—

"When the soil is a very close and retentive clay, the drains should be made proportionably near to each other, shallow, and filled with straw only, it being totally unnecessary to use wood, or any more durable material, upon land where the sides of the drains are not likely to crumble in. Upon a soil like this, the drains should seldom exceed the distance of three or four yards apart, and twenty inches deep, or such a depth as may be the most conveniently obtained, by first opening the drains with the plough, shovelling the bottom of the lowest furrow, and then digging one spit only with the land-ditch spade; and which, materials included, will cost about 2s. 6d. per score rods.

"Drains formed in this manner, through the tough and retentive clays, will be found, in a short time after the work is finished, to have formed, over the straw with which the drain was filled, an arch of sufficient strength to support the incumbent weight of the soil, and the casual traffic of the field. In twelve or eighteen months, it may be observed, that the straw, being of one uniform

* The author has seen drains filled with wood, in very deep moss, where the materials were apparently fresh, after having laid under ground nearly sixty years.

* Sir W. Cunninghame imported this mode of draining from Richmond Park, near London, where it has been very much practised.

substance, is all rotted and carried away, leaving a clear pipe through the land in every drain, into which the passage of the water may have been much facilitated, by a due attention to the filling of the drains with the most friable and porous parts of the surface the field might have afforded."

The latest and best improvement in filling hollow drains with straw, is that of twisting the straw into a rope, described in the following passage concerning some improvements in Essex:—

"The most prominent feature of his improvements, is a new method of filling land-drains: The common practice is to tread in loose straw; but Mr. Bedwell has invented a method of winding it into a hard rope, as large as a man's arm, which he forces to the bottom of the drains, and finds from experience, copied successfully by his neighbors, to convey the water off more readily, and to have much longer duration; at the same time, the quantity of straw consumed is not increased, and the operation of filling accelerated. After the cattle have picked it over, he finds the straw tougher, and in better order to wind, than when quite dry and fresh."

The next material to be noticed, is bricks made for the purpose.

They are effective, but expensive, and not so well adapted for surface-draining, except for conducting away springs, in which work a small extent of drains may answer for a large tract of land. These bricks are made of various shapes and sizes, but generally have a semicircular cavity for the water to flow in, and rest, in stiff soils, on the ground; in soft soils, upon each other, forming a circular tube, or on common bricks, as a foundation.

When small drains are wanted, and when the water is to be conveyed to a house, &c. No. 1 is commonly made use of.

For larger drains, No. 2 and 3 are well adapted, especially No. 3, invented by Mr. Couchman, of Bosworth Temple, in Warwickshire, and with which Mr. Elkington laid many of his drains.

They are laid single, without one reversed under; for, when that is done, the water running on the under one, occasions a kind of sludge, which in time becomes so encrusted on it, as totally to obstruct the passage of the water, and render the work useless in a few years. In clay bottoms they may be laid single, or without any thing under; but, in soft sandy bottoms, a common building brick should be laid under each side, to prevent them from sinking down, and should be so laid as to form a regular arch (*i. e.* the side bricks laid with an equal height,) the better to support the pressure above from breaking them, or causing them to slip. They may be constructed in the above shape, to any dimensions suitable to the quantity of water the drain is to convey. See plate.

In Essex and other counties, pipes of clay, about eighteen inches long, with an opening of three or four inches diameter, are burnt, and applied to similar purposes, but are best calculated for conveying any small rill of water, or spring, for the supply of a house, &c.

XI. *Mode of filling.*

There is one circumstance in filling the drains, attended to particularly by farmers who are most solicitous to have the work well performed, and that is, to contract with their men only for digging and leaving clean, in order that the filling may be done by men paid by the day, as a greater security that it should be executed with all possible care, and is usually attended by the farmer himself, or some confidential servant. This is a rational practice, and merits being followed. Mr. Young, of Clare, observes, in the paper quoted before, that "It is an invariable rule with me, never to suffer the man who digs, to cover up the drains, but it is left open for me or my bailiff to examine; and then it is well filled up to the shoulder with wheat-stubble, cut and stacked for the purpose immediately after the harvest, and a small stick or two at the outlet, to prevent is being stopped by any external accident. Lastly, with a common plough, I turn a furrow of the upper soil or mould upon the drain, taking care not to turn in any of the dead soil raised by the land-ditch spade, which ought always to be laid on the outside, and scattered over the land. It is right not to let the drains lie open any length of time, lest they get injured by wet or frost; my general rule is, to fill them up every day."

The different methods of filling, with stone, with wood, and with straw, will be better understood by examining the plate.

XII. *Of the expense.*

The expense of these drains will, of course, vary with the soil, depth, price of labor, &c.; and these circumstances are so different, in different districts, and even in different parishes, that it accounts for the varying reports of writers on the subject. The price in Suffolk, to dig and fill two-spit drains, is 3*s.* 4*d.* to 3*s.* 6*d.* a score rods. In the following notes of Essex draining, other rates are mentioned, and also the cost of materials used in filling, an article liable to equal variations with the labor.

Mr. James Young says—"It is not easy to ascertain the price of carting the wheat-stubble to the place where it will be wanted, and stacking it, because the value must depend upon the distance: it is equally difficult to say what the work of the ploughs ought to be valued at; for, though several acres may be drawn out in a day with one plough, yet I never choose to do above two or three hours work at a time; therefore I shall leave every farmer to fix his own price upon these parts of the business, only desiring him to consider, that it is work that will wait for a leisure time, and frequently, if the horses were not so employed, they would earn nothing.

"I pay for digging the land drains 1*s.* 8*d.*, and for filling them up with stubble 4*d.* per score rods. An active man, used to the work, where the soil is not stony, will dig twenty-three or twenty-four rods in a day, within working hours.

"The state of the expense, that is, the money a farmer will pay out of his pocket for draining an acre of land, will stand thus:—

"For cutting and raking together an acre of wheat-stubble, generally sufficient for an acre of drains, - - - - - -	£0	2	0
"Digging eight score rods of drains,	0	13	4
"Filling them up with stubble, -	0	2	8
"Extra work with the common spade,	0	2	0
	£1	0	0"

Lord Petre says—"The value of the work of the plough varies according to different people's methods. My general method is, to plough with a common plough, and a pair of horses, two furrows different ways, leaving a baulk in the middle, which I afterwards plough out with a larger plough, and three horses abreast, which will turn out a furrow about two inches deeper than the land is generally ploughed. The expense, not reckoning any thing for the master, who, I suppose, attends and marks out the ditches, is about 18*d.* per acre, ditches a rod apart. This method is for fallow. The labor of digging is 2¼*d.* or 2½*d.* per rod; and the expense per acre of the whole work is, as near as I can guess, on a fallow where two spits are digged, 43*s.* 6*d.* per acre; with the plough and one spit, about 35*s.*; on ley, with the plough, about 35*s.*; without the plough, and the spits set, about 47*s.* per acre."

Mr. Majendie's account of the expense to him is—

Digging the drains with the small or last spit spade, per score yards, - -	20*d.* to 24*d.*
Two spits in main drains, - -.	3*s.* to 3*s.* 6*d.*

In this manner the under-draining one acre (the drains at one rod apart), including wood, straw, and all other incidental charges, amounts to an expense of from 40*s.* to 45*s.* an acre.

XIII. *Of sod or pipe drains.*

Various methods have been devised of saving the expense of materials in the filling of drains. The sod or pipe drains are undoubtedly the least expensive of any, and may be of considerable benefit on some soils; but their duration and safety in supporting heavy cattle or horses in the act of ploughing, cannot be very much depended on, unless when the opening is at a consigerable depth from the surface, and when the upper mould becomes incrusted, so as to form an arch.

The method of executing them is by digging a trench of a certain width so deep; and then, by taking out the last spit with the narrow draining spade, a shoulder is left on each side, upon which a sod or turf, dug in grass land, is laid, grass-side downwards, and the mould thrown in over it. It is said that such drains will continue hollow, and consequently discharge well for a great number of years. The mode of executing them has been well described and the tools represented, by T. B. Bayley, Esq., in the valuable 'Georgical Essays' published by Dr. Hunter of York. *

Sod or turf drains are pretty much in use in some of the northern counties of England, where land stones are scarce.

Several mosses have been drained in Lancashire nearly in the same manner, by leaving shoulders about a foot and a half from the bottom, and laying over these, cross pieces of turf or peat, cut into lengths of sixteen inches, and eight or nine inches square, which after they have been dried by exposure to the sun and air, easily support the loose mould that is thrown in above them, the depth of which, being, for the most part, from two to three feet.

How long these drains, in such soft soils, may continue to operate, cannot be ascertained, as it is not long since the practice was first introduced.

*Octavo edition, p. 437.

Other modes of making pipe-drains have been successfully attempted; but they require no particular notice. The best and simplest of them have been described in Section 1st of Part III.

XIV. *Duration.*

The duration of hollow drains will necessarily depend on the nature of the materials with which they are filled, and, in some measure, on the quality of the soil; as certain kinds of the latter have the power of preserving wood, or other perishable materials, much longer than others.

Stones last till accidental causes impede the flowing of the water, and may last for ever. Wood perishes in certain periods; but it does not follow that the drains should then fail in their effect. If the earth forms an arch over the water-course, it will necessarily continue to flow; which is found to be the case when wood, straw, and stubble are rotten and gone. Drains that have been filled with bushes and straw, have been observed to run well, forty years after being made.

In the 'Annals of Agriculture,' it is observed that old drains, when cut across, though there was not the least appearance of any vegetable substance remaining in them, but full of loose porous earth, at once run freely, or, according to the workman's phrase, *bleed fresh.* From twenty to thirty years they continue effective.

XV. *Drainage of retentive soils by open cuts, and the proper formation of ridge and furrow.*

It has already been observed, that on some soils, where the surface is very retentive, no number of covered drains can operate effectually in draining, and afterwards keeping the ground dry.

In most of the central counties of England, and also in Flaunders, the general mode of keeping land dry is by ploughing it up in high broad ridges, from twenty to thirty, and even forty feet wide, with the centre or crown three or four feet higher than the furrows. The successful practice of the Flemings shows clearly how effective this method is, when well executed; for by attentively keeping the furrows perfectly free from water, the land is kept in so dry a state, that all sorts of crops flourish remarkably well; but, in England, the same observation would not be just, for want of the same attention to this mode of practice. In many instances, the furrows are not properly directed, nor properly deepened, and the ridges too flat; by which the water stagnates in the hollows, and of course renders that part of the field worse than lost. This bad management has brought the method itself into such discredit, that in many places they have been levelling their ridges at considerable expense, in order to adopt some other method of draining—an operation, which on clay soils, is certainly very imprudent; for when the ridges are well rounded, not too high, and the furrows kept open, and perfectly free from retaining water, it must be esteemed, for land of a very retentive surface, an excellent mode of draining, or for keeping it dry when the wetness arises only from surface-water. *

* Water-furrowing is attended with very beneficial consequences, when performed in a proper manner, and at those seasons when the land requires it. It is simple; but the omission of it may be attended with the loss of part of a crop; and wetness may often be removed by that means alone, without the aid of drains.

Much has been written against high ridges, but not with due consideration of their propriety in such lands; they have been applied on dry loams most absurdly; and from being perhaps a custom in that part of the country, no discrimination has been made; but their being improper in some cases, and ill-managed in others, affords no just argument against them, when well adapted to the soil and wetness of climate. *

They prove of great utility, even when united with either open surface cuts or hollow drains; as will appear from the following information transmitted to the Board of Agriculture on this subject.

Mr. Francis Goude, of Cossington, in Leicestershire, has united, in this manner, the ridge method and hollow drains in the furrows, and with a success that renders his account interesting.

He observes—"That his soil is sandy on the surface from six to ten inches deep; red clay at the bottom, and in some places gravel, which throws the water upon the surface of the land; which soil he finds not easily drained by cross cuts, but requires hollow drains to be made in the furrows of the ridges, which are made from five to ten yards broad. Their height varies; for summer corn, he raises them six inches, but for winter crops, twelve at the crown, above the bottom of the furrows. The hollow drains are thus dug: in turf ground, make the drain fifteen inches wide and two feet deep, going down sloping; first take a spade, and cut the turf out; then make use of another tool, made on purpose, something like a cheese-taster; at the head, where the man sets his foot, it is seven inches wide, becoming narrower downwards, to the length of sixteen inches, with which he digs out the other soil, whether it be sand, gravel, or clay: if clay, he cuts four inches deeper in the middle, at the bottom of the drain, and four inches wide, leaving two inches on each side, or what they call shoulders, to support the turf, which is laid flat upon it, with the grass-side downwards, and then fills it up again. If the land is of a mixed soil, such as sand, gravel, &c.; it is filled with thorns or elm boughs, trampled down, and the turf laid upon them as before, close to the sides of the drain, so that it makes as it were an arch; but where slab, slate, or stone, can be had, it is still firmer. The bottom of the drain is about four inches wide; and workmen have a tool made the same way as a hoe, or in form of the letter L, with a half-round at the bottom, to scoop out the particles of earth that may remain at the bottom of the drain. How long they will last good is unknown; but he can answer for fifteen years, and expects them to endure a much longer time, even filled with bushes; and the improvement may, upon an average, be estimated at one-fourth increase in the crops."

The mode of ridging and cross-thoroughing (furrowing) land in the Carse of Gowrie, Perthshire, has already been described in Section 5th, Part I, and is applicable and useful in all land of a similar description.

* One objection against raising ridges too high is, that the rain falling washes off more easily the fine particles of the soil from the sloping sides of the ridge into the furrows, in which it is carried off the field; and that the seed cannot be so equally disposed in sowing, and must be still more unequally scattered and drawn into the furrows by the harrowing: it likewise renders cross-ploughing more difficult.

XVI. *Drainage of clay soils injured by surface-water.*

The following method of draining clay soils, wet from rain or surface-water, has been practised by Sir Henry Fletcher, Baronet, a member of the late Board of Agriculture, with great success.

The upper soil, or that above clay, was from four to ten inches deep, and of good quality; but being in a mountainous part of the country, and near the sea, a great quantity of rain fell, which always kept the upper soil full of water, and produced a very coarse grass, not worth more than 3s. an acre. The substratum of clay was of very great depth. The mode he first pursued, and which proved too expensive, was the common one of the country; the drains twenty inches to two feet wide and deep, square, and filled up promiscuously with quarried stones to within nine inches of the surface. The quantity of stones thus requisite was so great, that the quarrying and distant cartage came abundantly too high; so that the total expense did not amount to less than 3½*d* or 4*d* per yard, and by the acre to £10. To lessen so heavy an expense, he changed the method to that which he has followed for many years, viz. on grass land he digs twenty-two inches, or two feet deep; the first spit is of the turf, taken so deep as where it separates from the clay, which is dug carefully out, and preserved unbroken, grass-side up, and laid on one side of the cut; then, with a very strong spade, eighteen inches long, six inches wide at top, and two at the bottom, he digs a spit in the clay, which the men spread about the land, on the side of the drain opposite to where the turfs were laid, as far as possible from the drain, so as none may get in again. A scoop, to clear out the fragments in the bottom, follows, which are also spread in like manner. They are then ready for filling; and in doing this, he takes three stones of a thin flat form, two of which are placed against the sides of the drain, meeting at bottom; and the third caps the other two, as represented by No. 2, in the plate of sections; thus a hollow triangular space is left to convey the water, which is subject to no accidents that can fill it up, or impede the current. Stones always sink deeper in the ground; and in the common method, this frequently causes stoppages, by their being partly buried in the clay; but the triangle, when it subsides, does it regularly, and keeps its form and passage for the water clear. One cart-load of stones, in this way, will do a considerable length of drain. They are carefully laid down by the side of the cut with a shovel, or basket; and if there are any small refuse stones left on the ground after the drain is set, they are thrown in above. The stones being thus fixed, the sods are then trimmed to the shape of the drain, and laid on them, with the grass-side downwards, and none of the clay used in filling up.

The expense is a half-penny per yard, the men earning 2*s*. and 2*s*. 6*d*. per day. *

*A man, his wife, and a child of ten years old, with a horse and little cart, made very good wages of it. The man used to cut the drains in open weather in winter; in frost he wrought in the quarry; his wife filled the stones and led them to the drains, laying them down along the sides at proper distances, and the child set them in the triangle at bottom.

It is always necessary to survey them twice, first, when the drains are opened, to see if they are of the proper depth; second, when the stones are set, before the sod is laid in.

In regard to the distance necessary from drain to drain, Sir Henry tried them at ten yards; but the spaces in the middle between them were not sufficiently drained. At five yards asunder they were perfectly effective, in the most retentive soil; at six, answered well; but he found that they would not operate a cure anywhere, if more than seven yards asunder. Drains made in this manner, give, after many years, no sign of failing, and will probably last for a very long period.

The English acre being four thousand eight hundred and forty square yards, the nearest square of that is seventy yards; and a square of seventy yards, drained at seven yards distant, is ten drains, of seventy yards each; consequently there are seven huudred yards of drain in an acre, or one hundred roods, of seven yards each, which, at a half-penny a yard, is £1 9 2, per acre.

When this is the price, the stones are not more than half a mile distant; if further off, allowance must be made for the extra cartage; or, when the ground turns out stony, hard, and difficult to dig, a farther allowance is then made.

XVII. *Of open drains.*

As the mode of forming open drains is the same in all parts of the kingdom, it is unnecessary to repeat here what has already been explained in Section 8th of Part I.

XVIII. *General utility of draining.* *

In Section 1st, of Part I, the advantages that arise from a perfect understanding of the theory, and judicions application of it in practice, especially on the principles of Mr. Elkington's system, as well in the draining of land, as in its application to other useful purposes, has been fully explained.

It is only necessary to add the further testimony of the following eminent agriculturists to the last species of draining, as described under the foregoing heads:

Of its effects on grass land, Lord Petre observes, that "the land, after draining, not being so much chilled by the long continuance of the winter water on the surface, produces earlier vegetation in the spring; the grasses are rendered of a better kind; the white clover is encouraged, which seldom fails in Essex, and in Hertfordshire, to chequer the *land-ditched* fields with its sweet appearance."† And again—"Tillage land is much more manageable; it dries gradually, and early in the spring; the bad effects of land being catched full of water, when the parching winds in March suddenly harden the surface of wet grounds, is prevented, and the earth breaks kindly. This, in a short time, alters the very nature of soil; the weeds and grasses change their color; every plant that grows, loses the appearance of rankness; the corn increases in quantity and weight; and every benefit a farmer can wish, is more or less the consequence of this first of all improvements, in proportion as the soil draws well or ill."

Respecting the farther advantages of the practice on arable land, he likewise observes—"the great advantage of land draining is, we can plough earlier in the spring, and later in the autumn; and it certainly makes the tillage easier; and the land can be kept clean with little expense; but it is too much for the farmer to expect his return the first crop. I believe I have known some particular piece that has repaid the expense in two crops. It certainly is a very beneficial improvement to the farmer."

Mr. Young of Clare, says—"I have a field that used to be so wet and poachy in the winter as not to be able to bear the weight of a sheep. I land-drained and fallowed it; then sowed it with wheat, without any manure, and had a crop equal to half the value of the land."

In speaking of the improvements in the county of Essex, Mr. Vancouver has the following remark on the importance of draining:—"There is no improvemt to which the heavy-land husbandry of this county owes so much, as to the fortunate introduction and continuance of the practice of hollow-draining. The means of melioration, and the consequent sources of fertility thence derived from the soil, over and above what it formerly yielded, are not more important and valuable in the present day, than permanent and precious, as they must prove in their consequences hereafter. The few instances of invincible blindness to the beneficial effects of this excellent practice, go no farther than to prove, that where the work is not improperly executed, it never ceases to fail in producing the desired effect."

CONCLUSION.

In the course of this Treatise, the writer has endeavored to explain the principles on which the art of draining land, &c. is founded; and to describe in such a manner, the various modes in which it has been, and may be practised in all parts of the kingdom, that intelligent agriculturists may easily comprehend both, and be enabled to apply it in all those situations where it may be requisite, and may be done with advantage. In the arrangement that has been followed, it is hoped that no material omission has taken place, in any branch of the subject; and that each has been treated in a clear and satisfactory manner, without entering too much into elaborate or unnecessary detail. The subject does not admit of fine language, nor does the writer aspire to such; but he trusts it has been explained with such perspicuity, as to render it sufficiently intelligible to the practical, as well as to the more scientific agriculturists, into whose hands it may come. It may be added, that, no part of the information herein detailed is is the effusion of theory alone, or of speculation; but is founded on the experience of upwards of thirty years, in giving plans for, and directing the execution of, all the various kinds of drains, in almost all the counties of Scotland, and in several of those in the neighboring part of the kingdom.

[The remainder of this work "On Embankments, &c," to be continued.]

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*The ancient Romans were so sensible of this, that Columella observes, "that wet land was fit neither for being ploughed, harrowed, nor planted."

†Annals of Agriculture.

From British Husbandry.

REPORT OF A FARM IN KYLE, IN AYRSHIRE, (SCOTLAND.)

Introduction.

There is no way in which a farmer may more advantageously improve himself in his art, than by inspecting the practice of other districts and of other countries; but as the opportunity of inspection cannot always be commanded, the want may be supplied by obtaining circumstantial descriptions. To derive the full benefit from either source requires caution and the power of discrimination; for in no art do so many circumstances combine in the production of the results as in agriculture, and a difficulty generally arises in determining to what cause a particular effect is mainly to be assigned. Individual sagacity without scientific knowledge may go a great way in solving this difficulty, and in determining to what extent an old course may safely be altered, or a new one introduced, why failure or success has ensued. We find that, in a certain place, the accumulated sagacity of ages has, without being able to ascribe any general principle for the effect produced, established, a practice suitable upon the whole to the circumstances of the situation—but if the perfecting the art in every situation be the object, the necessity of scientific knowledge cannot be too strongly impressed.

Theoretical and practical farmers have been sometimes contrasted to the discredit of the former. A mere practical farmer is a man who knows how to manage to good advantage a certain piece of ground. A mere theoretical farmer is a man who understands the principles on which the operations of agriculture depend, without having acquired dexterity in their application. The one may be less successful than the other at first, but place them in a new situation, or let them have to determine on the introduction of a new practice, there can be little doubt which of them, supposing them equal in intellectual endowments, will be most likely to succeed; or in the description of the farm to be here given, which will be most likely to detect what part of the system is erroneous, and what correct. Experiments in agriculture are carried on under many disadvantages. We have it not in our power to vary at will the circumstances in which they are tried, or to repeat an experiment in precisely similar circumstances, and thus we may be led to ascribe to a cause what does not justly belong to it. Fortunately, however, the results in agriculture have their foundation in sciences, in which we have sufficient control over circumstances, and in which the facts can be generalized, and principles established with the completest certainty. Chemistry and vegetable physiology afford the only sure means by which the art of agriculture can be brought to perfection, and Davy and Sinclair have done more towards its advancement, than might have been accomplished in centuries by practice unguided by science. Much has been done where the knowledge of general principles was wanting, but their use is to diffuse the capacity for improvement, to make its progess more certain and more rapid, and to prevent the adoption of error. Some person may, for instance, have raised an excellent crop after dressing his land with salt, and thousands of bushels are immediately applied as a manure, but no man who understood chemistry and vegetable physiology would ever have imagined that land could be made more fertile by such means.

There is every reason to expect that these sciences will soon be more generally understood. In towns, the means of acquiring the knowledge of physics is supplied to mechanics; and all other classes will be forced to keep pace with them. It seems absurd that any human being who can be kept at school for eight or ten years of his life, should arrive at the end of his education, in ignorance of the laws by which the events in nature around him take place. In relation to the aptitude of the human mind, this branch of knowledge might well be taught prior to that which is denominated literature, at least the one should accompany the other, and it is not difficult to conceive plans by which it might form a part of the course of instruction in even every country school, without much additional demand of time, or of expense. The usefulness of the knowledge here recommended is very obvious, and it is unnecessary to insist on the amount which it would add to the sources of pleasure to all farmers, whether proprietors or tenants. Every land owner living in the country, is to some extent a farmer, or a planter, or a gardener: there is not an object around him that can occupy his attention for a moment, in which his interest would not be much increased by the understanding of physical science; and yet what class in society is so generally unprovided with this fund of intellectual recreation, and resource against the tedium of idleness?

Description of the farm.

This farm, which lies in the district of Kyle in Aryshire, contains 250 arable acres, imperial measurement. Its offices are centrical. Its inclosures, which are rather unequal in size, are remarkably well accommodated with good roads. It is above seven miles distant from any place where manure can be got in considerable quantity, and two acres and a half are the most that have ever in one year been dunged from extraneous sources. In the above measurement are included five acres of rich sandy loam on an open subsoil, about four acres of mossy or peaty ground, and thirteen or fourteen acres dispersed in different places, of a deep alluvial clay soil. Generally speaking, however, the soil is poor, and rather tenacious, and, though very various in depth, may be stated at fourteen or fifteen inches as an average. The subsoil contains nothing noxious to vegetation, but is quite impervious to water. As in Ayrshire much rain falls through all the seasons of the year, the conducting of agricultural operations is, in these circumstances, extremely precarious and difficult. The ordinary farm establishment consists of a superintending servant, who directs the details and also engages in the farm work, two ploughmen, and two pairs of horses, two laborers, and a dairy-maid, besides a few female laborers occasionally weeding in spring and summer. By this force also a good deal of work not strictly connected with cultivation has been done. When the farm was taken possession of ten years ago, it was in a very exhausted condition. For seven years previously, the rotation had been either oats; oats; fallow; wheat; beans; oats; hay; followed by a few years pasture—ma-

nure applied to the fallow, but far too little in proportion to the extent and condition of the land; or oats; oats, without dung; hay; pasture for some years. Thus the land was in the one case too much exhausted before the fallow, and when laid down in grass, was in a poorer state than when broken up.

General system of management.

The object since has been improvement, with a view to which, it has been endeavored to get the fields laid down in pasture, in as good a state as the means of doing so, without too great a sacrifice of immediate return, would permit; and the rotations, adopted according as the land was more or less impoverished, have been oats; fallow with dung; wheat; hay; pasture for seven or eight years: or oats; fallow with dung; wheat; red clover and rye grass; oats; peas; oats with dung; pasture to be continued for at least four years. With respect to the first, none of the land thus laid down has yet been broken up, but it has returned as much in pasture as it could probably have been let for in its previous state under any system of management, and will, it is expected, yield proportionally well when brought again under tillage. With respect to the second, the crops, except the first one of oats, have been all good, and the land appears to be left in a good state to improve by resting. There are, however, two objections to it—the difficulty of getting a sufficiency of manure, and the difficulty—rather the impossibility, soil and climate considered—of keeping the land to the last from becoming foul. Probably a saving of manure might be effected with equal results, by applying the dung to the peas crop. A luxuriant pulse crop of itself fertilizes the soil. It draws much of its nourishment from the atmosphere; it protects the decomposable matter already in the soil, from exhaustion by the sun and weather, and adds to it by the decay of the lower part of its leaves under cover, and of the inumerable insects that infest them. In the only instance in which this mode of applying the manure was tried here, the crop was too luxuriant to be productive in grain, but the succeeding white crop* was very large. A balance of future profit is sometimes sacrificed to immediate gain, and it is believed that it would be a considerable improvement on the system, were this pulse crop raised with a view solely to fodder.

Such generally has been the mode adopted for the improvement of this farm. Were it once all gone over, perhaps a change of system might be advisable—a more uniform system decidedly so.

Before entering on details, the management of three inclosures of the better land formerly mentioned may be adverted to, as they have afforded a considerable means of ameliorating the rest. For the five acres of sandy loam the rotation has been, oats; turnips; potatoes; wheat or red clover; the crops always large. One inclosure of five acres of deep clayey loam, after fallow and wheat, was sown with rye-grass, cocksfoot, timothy, and white clover; and besides these, there is now in its herbage abundance of holcus lanatus, several varieties of fiorin, poa pratensis, with some of the other indigenous grasses. It was drained, but not sufficiently, and a part of it is infested with ranunculus repens, called crowfoot or butter-cups, which, in hay, cattle will not touch. It has been cut four years successively in hay, yielding nearly six tons and a half annually, and has afterwards been pastured till December with sheep. By proper management it might have been rendered a still more valuable appendage to a farm on which green crops can never be extensively or successfully raised. It ought to be thoroughly drained, and preparatory to being laid down in grass would require to be pared and burned. From a trial made on about one-fourth of it, an occasional top-dressing of dung would amply remunerate. The other inclosure containing also five acres, is a very rich alluvial clay, with a considerable, perhaps too large, an admixture of vegetable matter. At no great distance of time it was a swamp. In the centre of it there is a hollow filled up with moss, and springy, which has been drained, and the clay from the bottom of the drain and other sources laid to the depth of at least two inches on the moss, and it is now equally productive as the rest of the field. It was originally intended that this also should be converted into a permanent meadow, but the bulk of its crops has afforded a temptation to at least defer that object. When broken up, it was one mass of couch, the roots chiefly of a species of agrostis. It was fallowed in a very favorable season, got a moderate dressing of dung, and nine hundred and sixty Winchester bushels of lime, and was sown with wheat, drilled by an operation of the plough known under the name of "ribbing." Had the succeeding season not been remarkably dry, the wheat, from its strength, would have been lost. After being kept in stack for eleven months, the produce was two hundred and fifty-two bushels, and the produce in straw was comparatively greater than that in grain. Oats, hay, oats, potatoes, and turnips, have succeeded. The hay was bad; the field, should it ever be converted to permanent meadow, ought to be pared and burned, to extirpate the ranunculus. The oats were very bulky, the produce in grain of the two years together, four hundred and eighty bushels. This season the field is again in wheat, still a very bulky crop; but that after turnips is thin; and, considering this, and the wetness and coldness of the season, the produce in grain cannot be estimated above a hundred and sixty bushels. Viewed merely as a source of manure for the rest of the farm, these crops have certainly equalled what would have been drawn from the field, had it been laid down, as first intended, in the best state as a meadow.

Management of the rotation of crops.

1st. *Oats after pasture.*—Were it not necessary to take advantage of the first occasion of the land being in a proper state for harrowing, lest another may not in time occur, oats should not be sown here till the middle of April. Before that period, vegetation is so languid, that the plants are unable to resist the depredation of grubs; and if the land be poor, they never recover. The earlier and richer varieties do not succeed, and it is a material objection to them, that they are all deficient in straw; and on a farm dependent on the cattle-yard for manure, and on which green crops can be raised but to a small extent, this is a material objection.

2nd. *Fallow—naked.*—It was once tried to fallow a very poor field without previously taking

* A white crop is any grain crop.—Ed.

from it a crop of oats, but the breaking down of the turf sufficiently was found impracticable—the season, however, was remarkably wet and unfavorable. Five ploughings, with the usual assistance of the roller and harrows, are the most that have been found requisite to bring the ground into a sufficient state of cleanness and tilth for sowing. The ploughings should all be executed when the ground is in a dry state. The object is to clean, to pulverize and mix, and to render friable. One wet ploughing may undo the good effects of all the preceding operations, and had much better be omitted altogether. When lime is used, it is applied after the second ploughing, the dung is covered in with the seed furrow. There is no standard by which it can be said, with any degree of accuracy, what quantity of manure in the shape of farm-yard dung is applied. Carts are variously filled, and even when estimated by weight or measure, one is still in ignorance of the intrinsic value of the material. Where recent dung is used, if the land be very dry and loose, it is extremely difficult, in ploughing it down with the seed furrow, to bury it sufficiently, and when not well covered, a great waste is occasioned, and an obstruction offered in harrowing to sufficiently burying the seed. Ridges of fifteen feet width were at first, for many reasons, adopted; they are convenient in sowing and reaping, and when twice gathered, they afford, without rendering the furrows too bare, a quick escape for the water falling on the surface. When, however, the surface of the field has a considerable inclination, as is mostly the case here, twelve feet ridges are preferred. With these there is a less accumulation of water in each furrow, and the soil less washed away by the winter rains.

Fallow-green crop.—A small portion of the most suitable soil of the fallow is often allotted to turnips and potatoes, both planted in drills with dung. The latter are almost always an inferior crop in quantity. If the season be dry and warm, very good turnips may be raised on this soil; but as such a season cannot be depended on, were it not for the sake of advancing a few young cattle, they would not be sown. To cart them off in winter is ruinous for the land. For the last two years they have been stored towards the end of October, and with probably less loss than might have been expected, had they remained on the field. They are laid down on a dry place in long heaps about five feet wide, and moderately covered with straw. They should be protected from rain and frost, and at the same time the air not excluded from them. Swedes are the turnips which are most desirable to plant, but they do not succeed if not sown in the month of May. It is rare that the land can be got prepared so early, and therefore the yellow bullock is substituted, a root very little inferior, if to be used before the end of April. The potatoes are raised principally for the use of the servants and family. In winter, and when there is no whey, the pigs are fed with them boiled; and in spring, when the cows begin to calve, they get a few bolls of them. The turnips are almost exclusively given to the young cattle.

3rd. *Wheat*—should be sown early in September. In proportion as it is sown later, it seems to be deficient in produce. One season a little was sown on the 13th August, and succeeded equally with the rest of the field; the spring, however, was fully more backward than springs are generally in this country. The white wheat is the kind that has always been sown, though perhaps not the most suitable. Three bushels an acre is enough; if sown later, or, when the land is very wet, a little more is required. It is washed in stale urine, and dried with slaked lime before being deposited in the field. It has, however, been repeatedly tried without washing, and in neither way has it ever been affected in the slightest degree with any disease. Sixteen and a half acres is the average extent sown annually since the farm was taken possession of. The average produce for each year has been as low as seventeen bushels per acre, and as high as thirty-four; and the average produce of all the years is twenty-five bushels per acre or thirty-one and a quarter per acre, Scots.

4th. *Clover.*—Red clover, with rye-grass, generally succeeds well here. It affords the principal means of feeding the horses and calves in the house all summer and autumn. It is sown among the wheat most commonly in the month of March, and four pounds of clover-seed has always been found sufficient for an acre. A great part of the first cutting is converted into hay, and made early, for the sake of the after-crop of clover.

5th. *Oats after clover.*—If the crop of clover be good, the succeeding oat-crop never fails.

6th. *Peas.*—The common grey is the kind used, sown broad-cast at the rate of about four bushels to the acre. Peas are preferred to beans, because they do not require to be so early sown; and they are ready to be cut sooner in the autumn; they are besides more easily secured. It is desirable that they should be drilled, for the sake of getting the ground kept free from weeds, though in many seasons the horse-hoeing of them would be impracticable.

7th. *Oats after peas with dung.*—If the pea crop has been luxuriant, the oats that follow are so also. The ground gets two ploughings, by the last of which the dung is covered in. Three ploughings would be better, if they could be overtaken, but it is seldom possible to get two performed with the ground in the requisite state in point of dryness.

8th. *Hay.*—It is allowed to lie in the swath till ready to rake, and to be put up into small cocks, which in fine weather may be the second day after cutting. In these it remains for a few days more, and is then put into small ricks of from fifty to eighty stones of twenty-four pounds, and when sufficiently dry, is carried home and put up together in a permanent rick. In this way it is as little as possible exposed to the influence of either good or bad weather.

9th. *Pasture.*—The land here will not stand constant cropping, or continue productive, without considerable intervals of rest under pasture. If the pasture is to follow the wheat crop, the grass seeds are sown in spring, and an occasion ought to be taken, if it can be got, when the wheat may be well harrowed and rolled. The grasses, however, are found to succeed well without harrowing, if sown early. Upon half an acre it was once tried to sow the grass seeds with the wheat in autumn. The wheat crop was remarkably injured by this mode of proceeding, but the grasses seemed proportionally benefited, and probably the

land was not more exhausted by the grasses ripening their seed, than it would have been by a full wheat crop. It has been recommended to sow grass without any grain crop along with it. In this climate and soil, it is impossible to bring the land into the requisite state of filth and cleanness, without a fallow in the middle of summer; and, judging from the above experiment, it might not be unadvisable to sow wheat to the extent of half the usual quantity along with the grasses. The young grass plants would be materially protected by the wheat during the winter, and the whole might be either pastured in the ensuing spring, or made into hay at a later period.

If the pasture is to follow the oat crop with dung, when the oats have been sown and the land harrowed, the grass seeds are sown and the field rolled. If the land be not fine enough, it is rolled and harrowed previously to sowing the grass seeds, and then rolled again. The sowing down is an important operation, for under good pasture land improves much; but if the pasture be poor, it improves not at all.

The only grass sown in this district is perennial rye grass, the very worst for pasture, as cattle reject its shot stalks, which impoverish the land by ripening much seed. It would be a great improvement to sow along with it some of the grasses natural to the soil. Many of those that are the most abundant, produce a great deal of seed, and every farmer might at little cost supply himself with them from his farm. By this means a better turf would be had from the commencement, while, by the ordinary process, a considerable time is lost, and the ground in a great measure occupied by more worthless plants, before these grasses make their appearance. Unless the land be in good condition, and unless there be shelter, it is needless to sow the more valuable species of grasses. Those sown on this farm besides rye grass, the clovers, and rib grass (plantago media,) are timothy, and cocksfoot, of which the seeds are raised on the farm. The rough stalked *poa* (poa trivialis) has also been sown, and increased much the bulk of the crop of hay, but it immediately becomes dwarfish. Besides requiring shelter like the cocksfoot, it must have a deep soil. It produces seed abundantly. The timothy seems to be a very hardy plant, and very permanent, and no grass produces more seed. It is a great omission not to raise and sow the varieties of the fiorin also, for though fiorin immediately rises spontaneously, it is one of the best pasture grasses that are here indigenous. White clover is luxuriant for two or three years, but after that it, generally speaking, disappears. Sheep are fond of rib grass, and it puts out its foliage very early in spring, but cattle seem little disposed to eat it, and as it is always shot before they can be admitted to pasture, it is rather injurious where they are the only stock.

From the wetness of the climate and the large proportion of clay in the soil, it is not in general advisable to pasture grass land the first year: if done, it must at least be with sheep alone. In a dry season; there is no doubt that to stock early with sheep is most conducive to the fertility of the pasture, and the future improvement of the land, but, upon the whole, the safest plan for the first year, is to use the scythe. In such a season as the present (summer 1830,) cattle do immense injury on pasture of even two or three years standing; and care is taken not to admit them, if possible, to fields recently laid down, except in dry weather. A considerable number of dairy cattle are kept on this farm, but for these and other reasons, it is thought that sheep ought to be its prevailing stock. From every consideration overstocking is avoided. It is a most short-sighted error too commonly fallen into. If eaten bare on such land as this in the early part of the season, the pasture never again recovers. After the commencement of autumn the grass grows very little, and if there be not then a full bite on the fields, the cattle, especially milch cows, will go to the fodder in bad condition; it will be impossible to keep them in health through the winter, and when again turned out to pasture, a great loss will be sustained before they come into a productive state. Under heavy stocking too, the pasture on land so ungenial never improves, and the soil consequently receives no amelioration.

Draining.

As a means of improvement, draining is the most important, the most permanent, and that which ought to precede every other. The drainage hitherto accomplished here, has been chiefly applied to carrying off water rising from the subsoil or springs. The most effectual amelioration, however, which land such as this farm consists of, can receive, is from what has been called furrow or surface draining. The greatest defect of this soil is occasioned by its shallowness, and the retentive nature of the subsoil, in consequence of which, the water falling on the land has not a sufficiently rapid vent. These drains are cut into the subsoil, so as to deliver the water as it approaches its surface. The distance at which they are placed must depend on the soil's depth, and the degree of facility with which water can pass through it, a drain doing more execution in a porous and deep soil, than in the reverse. Here from twelve o eighteen feet seems a sufficient distance. Though it has not hitherto been possible to accomplish much of this kind of draining, yet as all the drains that have been made, have been finished in such a way as to act also as surface drains, there has been sufficient experience to warrant submitting a description of them.

If the soil be of eighteen inches depth, six inches taken out of the impervious subsoil affords sufficient security for a drain; but however shallow may be the soil, the bottom of the drain should, at the very least, be twenty inches below the surface; for less will not admit a sufficient depth of stones to render the exit of the water forever certain. The trenches are opened a foot wide at the surface, and diminish in width towards the bottom. If the clay forming the subsoil be solid, the trench in it is thrown out with a wedge shaped spade, whose point is three inches broad; and this effects a saving of stones, but in other cases it is safer to have the bottom seven or eight inches wide. In opening the trench the soil is laid down nearest to it, and the clay thrown furthest off, *so that no part of it may be returned.* The next operation is the filling up of these trenches. The rubbish of a freestone quarry within the farm is the material used. When the bottom of the trench is soft, it is flagged with thin stones, and if

the quantity of water to run in it is considerable, a conduit is made with side stones and covers; otherwise the stones are thrown in without placing, beginning with the largest, none of which are the size of a man's fist, and finishing with the smaller, which are freed from sand by being thrown into a riddle. When brought within ten inches of the surface at the furrows, the upper part of the stones is consolidated and closed together by means of a hammer. It often happens that there are not ten inches of soil at the furrows, in which case the trench is further filled up with the sand extracted from the small stones, and as a plough passing through this can in no way injure the drain, it may safely, if requisite, be carried up to the very surface. Constructed in this way, it is not easy to conceive how a drain should ever become inoperative.

It is obvious that, that by this mode of draining the defect arising from a retentive subsoil, may be most completely remedied; to obviate the evil of shallowness of soil would require, in addition, trenching to the depth of ten or twelve inches. The expense of the operation must in every situation vary with the distance of the materials and the facility of obtaining them. Here the drainage of an acre of land may be completed, according to the distance from the quarry and other circumstances at the rate of from £4 to £6; an outlay very trifling, when compared with the extent and permanence of the benefit derived from it. On the estates in this county belonging to his Grace the Duke of Portland, surface draining has for several years been carried on to a great extent. These drains are constructed with single arched tiles, upon which the soil is returned and the subsoil is scattered on the surface. It is considered that by this means his Grace has accomplished a very profitable amelioration. Except in very rare cases, the drain made with tiles is less expensive than that made with stones, and where the soil is easily permeable by water, the one may answer as well as the other; but where the soil is tenacious, one would suppose that the access to the conduit formed by the tile must be difficult. In any kind of soil, however, it is not possible that a drain formed in this way can be as efficacious, as one done as above described with the freestone rubbish, where an open pervious mass may be brought up if necessary to the very surface. *

Manure.

Of this, almost the only source here is the farm-yard, and, considering its value, and how much that value depends on its treatment, it does not yet receive all the attention it deserves. On a farm of this extent, on which there has never in one year been above three acres of turnips and four of potatoes, it is perhaps a good deal to have manured eighteen acres in a season, from the farm-yard and the servants' cottages; and yet there is no doubt a great deal more might have been accomplished, as respects both quantity and quality. If exposed to rain, the most soluble and richest parts are carried off. Observe the luxuriant vegetation wherever the dark liquor from a dunghill touches, and the loss may be estimated. If allowed to come into a strong heat, its substance may be seen passing into the air. The only part of it that requires rotting or fermentation to render it soluble and fit to become food for the roots of plants, is the woody fibre of vegetables; the slower, however, and more confined the manner in which this process goes on, there will be the less loss. Some practical farmes have advocated the use of dung in its recent state, others have said it should not be used till well rotted. But if in the process of rotting it palpably undergoes waste, the place in which it must with most advantage be rotted, is under the soil of the field. There is then no loss that can be avoided. The fallacy in this controversy arises, it is suspected, from not adverting to the circumstance, that equal bulks of recent and of rotted dung contain very different quantities of the food of plants. In the latter it is more concentrated, and in a state fitter to be immediately consumed by their roots. But the correct way of stating the question is this: having a given quantity of recent dung to apply to a given extent of land, is it not better to plough it down in its recent state, than previously to allow it to ferment and rot in a heap? In the first case, there is no loss; the decomposition goes on as slowly as possible, and all the elements of the substances of which it is composed are retained in the soil as they are set free. In the second, the decomposition is rapid, and a much larger proportion of matter will be found to have flown off than could easily be imagined. Any person without the aid of knowledge of chemical principles may satisfy himself on the point by an easy experiment. Take two acres of ground of equal quality: take twenty tons of recent dung, which apply to one of them: take twenty tons of the same dung and put it up in heap till it become a black solid mass, and then apply it to the other acre, balance the produce of the one against the produce of the other, at the end of the fourth year, and if the experiment be well conducted the result ought to be satisfactory. A knowledge of chemical principles leads to the inference, that dung ought to be used in its recent state, and any disappointment which, in practice, may have attended the adoption of this inference, will be found to have arisen, not from a defect in the theory, but from a want of due observation of circumstances in its application. If immediate effect be absolutely requisite, as in raising turnips, then rotted dung must be used; but care should be taken in preparing it, to prevent its heat from rising high, or any of it from escaping, either in a liquid or in a gaseous state. This is best accomplished by compression, and by covering well up with earth.

To increase the manure raised on the farm is a constant aim. A large portion of the straw is consumed by the cattle and horses, and no hay is ever sold. A considerable quantity of vegetable matter is collected from plantations and waste places, and with this, and the refuse straw, the farm-court and the approaches to it are kept littered so as to collect the droppings from the cattle and horses. The whole is occasionally carried off to the dung heap, and new litter applied. It is surprising how much dung may be produced by constantly collecting all refuse, which, if allowed to lie, would soon disappear. The horses are ne-

*It is to be feared that the draining done by the Duke of Portland, in Ayrshire, and executing by his Grace in Northumberland, will, in a few years, be entirely useless, owing to no stones being put in the drains over the tiles.

ver allowed to pasture; from the 1st of June to the end of October, they are fed in the house on green food, consisting of red clover, rye-grass and vetches. The calves that are reared are also fed in the same way in a yard, and in the course of the pasturing season, convert a great deal of vegetable matter into excellent manure. There are always, too, at this season, a few pigs fed entirely on whey; and by these means much dung is made even in summer. There is no danger of dung made by animals in yards overheating in the warmest season; but without considerable precaution, stable litter will then be very soon consumed away. For the purpose of preventing its rapid fermentation, peat moss was for some years used and regularly mixed with it in layers; but earth of any kind, or road-scrapings, will be found to effect the purpose, and in winter the cleanings of the cow-houses answer the end. What is made in spring and summer is taken to the fields as it is needed, and in winter it is taken to the field as often as possible, put up into heaps over which the horses and carts pass, and then well covered over with earth.

Lime:—To bring the land here to its greatest fertility, lime is essential; and to use it in large doses, and at distant intervals, is thought to be the most advantageous way of applying it. From one hundred and sixty to two hundred Winchester bushels per acre, are considered about the proper quantity, though one half of that accords with the practice of this district, where it seems often to be applied as if it were a substiture for dung. In most vegetables a little lime is found; every good soil contains a small proportion of it. This proportion, if wanting, ought to be supplied; and it would seem to be more advantageous to supply it at once, than by degrees, and at intervals. Hot lime indeed, tends strongly to promote the solubility of inert vegetable matter in the soil; but to produce a given effect, the smaller the quantity of this matter in the soil, the greater er ought the dose of lime to be. The quantity of it entering into the plants themselves is so small, that it seems to be chiefly by its affinities for water and for the other constituents of the soil, that it influences vegetation. It has been often observed in fallowing this clayey soil, that in wet weather, where a dose of lime has been just given, the land continues more friable, and is less apt to bind up on the recurrence of drought, than the rest of the field of similar quality. The grain growing on the well limed ground preserves its healthy appearance in wet seasons, while that growing on land that has not been limed is yellow and sickly. Wherever lime is laid upon pasture, the herbage assumes a more healthy color; and though coarse before, is immediately eaten closely down by cattle. This is the case, though it be applied in a very moderate dose, and it is so to a much greater degree than would happen were manure in the shape of well rotted dung, applied in far larger quantities than the inert vegetable matter in the sward can be supposed to afford through the action of the lime. For top-dressing pasture, the best mode of applying it is in compound with earth. Sometimes the full dose has been laid upon the sward a year previously to being broken up, but it seems preferable to apply it in its caustic state, while the ground is under fallow, when it can be most intimately mixed with the soil. The lime-stone is imported from Ireland, and burned on the spot in kilns made of turf. When ready to spread upon the land, its cost, including the cartage of the stone, and all other charges, amounts to about eightpence a bushel.

The securing and manufacturing of the crops.

The result of the experience of this farm is decidedly, that all grain, but especially wheat, should be cut without regard to its color or the greenness of the straw, as soon as milky juice can no longer be seen on bruising the pickle with the fingers. The extent of the loss sustained by the reaping of wheat being delayed for eight or ten days beyond this period, is very great. The best of the grain falls off in handling; and the sample is not so fair as that of grain cut even before the milkiness is quite absorbed. The wheat when cut, is set up in shocks or stacks of eight or ten sheaves, covered with a couple of hood-sheaves, and if this operation be well performed, it will stand a week's rain without injury. In this precarious climate, oats ought always to be hood-sheaved too. Peas are not sheaved, but left loose, and frequently turned. If the grain be in a doubtful state, care is taken to make the stacks small. A considerable part of the crop is stacked on frames supported by pillars with coping stones, and the whole ought to be preserved in this manner. Vermin are thus excluded, and the air circulates beneath the stack, and to any extent may be conducted through it by vents. The mode of stacking peas, chiefly adopted, is to build them round a high square of triangular frame, to which the air is freely admitted.

The crop is thrashed by a mill driven with great ease by three horses. In general, as much straw is thrashed each morning as serves the cattle for the consumption of the day. No oats are sold; they are converted into meal for the sake of getting the dust and shelling, which are found very useful in feeding the horses.

The live stock and its management.

1. *Horses.*—Moderate sized, active horses are used. An effort is made to feed them as long as possible on green food, as the most economical, and as most conducive to the increase of manure. The means employed, are clover and rye grass assisted by vetches. While on this food, and at ordinary farm work, they get no oats. When the green food fails, about the end of October, hay is first substituted, and, as the days shorten, oat or pea-straw. They now get each two feeds of oats in the day, or one fifth of an imperial bushel. In cleaning the oats, the weaker are separated for the use of the horses. These are again put through the fanners, or winnowing machine, and the refuse is used in making boiled food for them. Before breakfast, a boiler is filled with oat or wheat chaff, or cut hay, mixed with a little of the refuse oats, or a little refuse wheat, or a few peas, or a few potatoes, certainly not equivalent in nutriment to half a feed of oats to each horse. At dinner time the contents of the boiler are emptied into a cooler, and mixed with some of the oat dust mentioned above, and of this, each horse, when his day's work is over, gets about a pail and a half. They get a great deal more fodder than is necessary, having always placed before them as much as they can destroy. It is conceiv-

ed that sixteen or eighteen pounds of good hay would be enough for each; but there is no innovation which the farm servants have resisted with more perseverance than this, and the horses are allowed at least a half more. They are very constantly and regularly worked nine hours a day, and are very seldom a day idle; on this regimen, they have been always healthy and in good condition. The state in which a horse is capable of the greatest exertion and speed, is not one most conducive to health, and for a horse employed in ordinary farm work, rich and concentrated food is not only unnecessary, but injurious. Green succulent vegetables are alone quite sufficient for him. When this cannot be had, and there are no turnips, boiled grain and chaff are, to a great extent, a substitute, and the food described as given in this shape, might, it is believed, be beneficially increased. This supposition is founded, in some degree, on analogy of what has been observed in feeding milch cows and young cattle. When cows that are feeding on straw or hay get boiled chaff, their bowels are immediately brought into a healthful state, and their condition instantly improved, and a very small quantity of turnips, half a dozen even, a day, produces similar effects. These effects proceed not from the addition of nutriment supplied by the boiled chaff, or the turnips; but from the power which these give to the intestines to extract more nourishment from the fodder. It is not unlikely, that if all the oats the horses get were boiled with chaff, a smaller quantity would be sufficient.

2. *Sheep.*—The most profitable stock of this description that has been tried has been black-faced, or Cheviot lambs, purchased in the month of August, and sold to the butcher the following June and July. For the first two months of spring, however, the pasture is so exceedingly bare, that they were found very difficult to keep within the fences, and ewes are now substituted. They are purchased as soon as the grass is up, the lambs are sold as they become ready to kill, and the ewes are fit for the butcher by December.

3. *Cattle.*—These are entirely the Ayrshire dairy breed, and are both a dairy and a breeding stock.* From fifteen to eighteen is the number of cows kept, and six or seven gray calves are annually reared. The calves get from ten to twelve quarts of new milk a day for the first six weeks. By the time they are ten days old, they will eat a little, and are supplied with hay and grass. They are then gradually weaned by mixing the new milk with an increasing quantity of skimmed milk, or the whey of new milk cheese. When two months old, they get whey alone, which is continued to them through the season. They are allowed to run loose in a yard with a shed, and are supplied with green food in cribs. When the green food is at an end, they get, with straw, as many turnips as can be afforded to them, generally, a small quantity. The second and third seasons, they are pastured, and in winter, get with straw, a small portion of turnips, if they be to spare.

Experiments on the nutritive matter in the straw of different kinds of grain, similar to those conducted by Mr. Sinclair relative to the grasses, are very desirable. Horses and cattle seem to eat the straw of beans and peas as readily as hay; and the experience of this farm leads to the belief, that the straw of wheat possesses much nourishment. It is coarse and woody indeed, but contains a great deal of saccharine matter; and if used with a very small addition of turnips, the cattle are found to thrive on it. Last season, there were fed here from the beginning of November to the middle of May, eight grays, rising three years old, five rising two, and five rising one. They had two acres of yellow turnips, a middling crop, and the oldest two lots had nothing besides but wheat straw. The largest proportion of the turnips was given to the youngest lot; for some time, the eldest two got scarcely any, and for six weeks previous to the grass, wheat straw alone without a turnip, was the food of these. They all grew well, and retained their condition, and no falling off on the part of the latter during the last six weeks was perceptible.

There is no reason to doubt that the mode described, of feeding during the first season, is preferable to pasturing. Besides the excellent dung produced, the animals arrive, under this treatment, at a much greater size. As they approach having calves, some of them are sold, the best being selected for the dairy, where they are milked for three or four years. They often have calves at two years old, and if they have previously attained sufficient size, and the feeding be afterwards good, a milch cow is thus obtained at very moderate cost; but otherwise, they will remain small, and probably not take the bull again the season after calving.

The Ayrshire cows are generally allowed to be the best that are known for the purposes of the dairy. In the end of autumn, when the nights become cold, they are kept in the house after sunset, and get a little fodder; and from the middle of November, till the pasture be again ready for them, they are fed entirely in the house, and let out only in fine weather to get water. They are regularly curried, and kept as clean as possible. Having not a sufficient quantity of green crop to supply them with succulent food, the milk is put off them as quickly after they are taken from the grass as it can with safety. Those that are to calve late in spring, and are continuing to give a considerable quantity of milk, get a little extra feeding; the rest have straw alone. When the calving time approaches, they get chaff or cut hay boiled in a good deal of water, and enriched with a few potatoes, or a little pea-meal with hay to eat. In this way, they go to the grass, which happens in general about the middle of May, in as good condition as when they left it. No food is found to produce so much effect as pea-meal, and will be profitably bestowed at the ordinary price of the grain; and though given in very moderate quantity.* Till the beginning of June,

* An excellent account of this breed of cattle, and of the dairy system, will be found in a work published a few years ago by Mr. Ayton. The book is not at hand, but the title of it is believed to be "Ayton's Account of the Dairy Husbandry of the counties of Lanark, Ayr, and Renfrew."

* Take a bushel of chaff and eight or ten sound yellow or Swedish turnips, having the tops and tails carefully taken off, and boil them together four or five hours. Add as much water as will cause the hand to move easily through the mass. Squeeze down the turnips, and add three pounds of pea-meal. Give this to

they are seldom allowed to lie in the field during the night, but though they are protected as much as possible from cold, their houses are at all seasons kept well aired and cool.

The cows are milked twice a-day, and the pro duce converted chiefly into sweet milk cheese, that is, cheese made of the entire milk as taken from the cow. In such a situation as this, as to climate and soil, it is probably impossible to make cheese having the fine flavor of that of Glocester and Wilts; but for some years past the production of a rich, mild and palatable chees has been attained. Any person desirous of knowing the details of the most approved mode of cheese-making, in this part of Scotland, is again referred to Mr. Ayton's work. It may be sufficient here to notice one or two peculiarities. The milk is not allowed to cool, but thickened as taken from the cow. If the milk be allowed to stand till the cream separates from it, the cream can never again be completely blended with it, or retained in the curd when set, and the cheese is poorer, and this, without great care in the management, to a considerable extent. The bad qualities of cheese may be produced in a variety of ways; but there is a certain rankness of flavor which it is conceived is the effect of the pasture, at least it could be attributed to no other cause here. This has been uniformly overcome by throwing into the pail before each cow's milk is drawn into it, about the half-full of a tea-spoon of saltpetre. On this subject, however, it is more easy to speak as to results, than to state precisely their causes. It would conduce much to perfecting the art of cheese-making, were a series of experiments completed for ascertaining the general principles on which depends the great variety in its products.

The average produce of each cow, exclusive of her dung, has been £6 17*s.* and the pasture allowed to each not less than three acres. The deductions are obvious, such as the dairy implements, the dairy-maids' wages during the pasturing season, and interest of the value of the stock. From the way, however, in which the latter is managed, there is no deterioration of it, as unless on the supposition of a constantly falling market, the cows should be of as much value when sold as when taken into the dairy. In a situation unfavorable for tillage, and especially on small farms the dairy is certainly a profitable mode of husbandry. Its success depends on constant attention and minute care, and on a small farm it is managed by the farmer's wife and family, while the offal goes a great way towards their sustenance.

4. *Pigs.*—They are peculiarly valuable in connexion with the dairy. The breed is small, and they do not exceed fourteen or fifteen stones imperial weight at a year old, but they are very hardy and remarkably easily fed. During the cheese-making season, they get whey alone, on which food they become quite fat. In winter they have boiled potatoes. A breeding sow is kept. Her spring litter is disposed of. As many of her second litter are kept as are necessary for killing in winter and spring, and for the consumption of the whey of the ensuing season. Those intended for the latter purpose are allowed to have pigs about the beginning of July, when they are ten months old. The having pigs does not seem to affect their growth, and they are disposed of about the end of November. In this way the litters have more than redeemed the cost of rearing the mothers.

Fences.

A considerable extent of new fences have been made, chiefly hedges. Having an unlimited command of freestone at hand, stone fences would have been both the most immediately useful, and, in the end, perhaps the cheapest, but they are not so handsome as hedges, and do not afford so much shelter. On a thin and adhesive soil, it is very difficult to rear and preserve quick fences. A mixture of beeches and thorns is what has been used, but from the experience had in attempting to fill up gaps in old hedges, crabs are recommended as decidedly superior to thorns for all tenacious poor soils, and in such soils beeches will make a fence and afford shelter where no other tree will. The plants were placed from ten to twelve inches asunder. This distance is quite close enough for the purpose of a fence; and it is obvious, that the more plants that are put into a given space, the less chance there is of their thriving, especially if the ground be unfavorable. In such a situation it is very material to avoid cutting them till they have gained some strength and size; and, unless where very luxuriant, they have not been brought into shape with the pruning knife till at least after three years old.

Farm accounts.

A farmer cannot know with accuracy wherein the system pursued by him is judicious and profitable, and wherein defective, without keeping accurate accounts of his receipt and expenditure. Keeping accounts, however, is too generally neglected, though besides its economical usefulness, it would be found an additional source of interest in every operation. The account kept for this farm, though simple, is sufficiently comprehensive. It is balanced once a-year, so as to show the amount of the annual return. There is an inventory with the value of the whole stock. The amount of this inventory is the first entry on the debtor's side of the account, and it is followed by every item of expenditure during the year. The other side contains the receipts. When the account is to be closed, it is debited with debts due by the farm, and with a per centage on the capital invested in the different kinds of stock, and it is credited with the amount of the inventory of the whole stock, as then taken—including debts due to the farm. In making up the inventory, instead of valuing anew every article of the implements and working cattle, ten per cent. is deducted from the previous value, for deterioration, and balancing five per cent. is charged on the capital invested in live stock, in seed, and in the produce on hand. If to know the returns and expenditure in any department be required, the information is easily taken from this account, and the

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a cow in the morning, and the same in the evening, and as much sweet hay as she will eat up clean five times a day; and without much expense, her butter will be as rich and of as fine a flavor as can be produced in winter. Should the peculiar flavor of the turnip be detected, which is not likely, a small quantity of salpetre put to the cream will take it off.

balance, as applicable to each year, is sufficiently accurate for use. A form of the account will be given at the end. The only other that is kept is one for the barn. In this there is a place for each kind of grain—the grain thrashed is set down on one side, and the disposal of it on the other; and, when milled, the meal is entered separately in a similar way.

General character of the district and of its agricultural occupants.

The soil is, generally speaking, thin and tenacious, and of difficult cultivation. There are few large farms, and few of the tenants have any capital beyond what is invested in their stock. The pasture is universally occupied with dairy cattle. During the latter years of the last war, from the high price of grain, too great a proportion of the land was brought into cultivation; wheat was sown to a great extent with little manure, and the land reduced to a state from which it is, except in the vicinity of towns, extremely difficult to recover it. The tenants had afterwards to struggle between high rents and very reduced prices, which led still to a continuation of the evil, as well as to crippling their subsequent ability. The alteration in the value of money, the distressed state of the classes of the community, have also had their share in the difficulties of the tenants' conditions, and in the consequent injury to the land. Though landlords have, on the whole, adjusted rents as liberally as could be expected, the necessity for further abatement has been regularly progressive, and there is no reason to doubt that for seventeen years past, rents have been too high. The effect of this state of things is, that if a tenant had capital, he lost it; he was unable to make the necessary outlays on his farm, and forced to scourge as far as he could. But the price of every item of agricultural produce seems now to have reached its lowest verge; and if the value of money do not increase further, and if the nation allow the land-owners to retain their monopoly, there is a prospect that rents will come to be properly and permanently adjusted; an ameliarating system of management pursued, and the soil brought to be as productive as its nature will permit. In the course of years, by less frequent cropping, by pasturing longer and stocking lightly, improvement may be accomplished. No hay should be sold, and no wheat sown where there is not an abundant command of manure. When a landlord can get a tenant of tolerable skill and integrity, it is bad policy to exact a burdensome rent from him. Farmers, especially those of little capital, are apt to offer too much for their farms: they can turn themselves to no other occupation, and are disposed more than any other class to be content with the smallest profits.

Peasantry.—The farm servants and laborers are in general in a situation of comfort. The annual wages of a married ploughman are from £12 to £15 in money, a house and garden, six or six and a half bolls of oat meal of one hundred and forty pounds, and five bolls of 432 lbs. of potatoes. The people who compose the agricultural population are of the best description. They are industrious and well-disposed, and as free from vice as consistent probably with the existing state of society. The instances of their requiring parochial aid are rare, and in the parish to which this farm belongs, the whole list of poor is made up of aged and infirm persons, and widows with young children. There is no poor-rate levied in this parish. The funds for the poor are derived from the collections at the church-doors, and from a small voluntary contribution by the proprietors of land. The population is about seven hundred; the number on the poor-list last year was ten, and the sum expended on the poor £42 10s. The situation of the whole district in this respect is understood to be similar.

Form of the farm account for one year.

1829. Dr.	1829. Dr.
Jan. 1st. To stock at this date -	Jan. 1st. By debts of last year due by the farm
1st. Barn implements - -	(Here follow the receipts for the entries of the year.)
2d. Field do.	1820.
3d. Stable do., harness, &c.	Jan. 1st. By value of stock at this date per inventory, including debts due to the farm
4th. Dairy do.	
5th. Work horses - -	
6th. Live stock	
7th. Debts of last year due to the farm -	
8th. Seed sown for ensuing crops	
9th. Produce on hand - -	
(Here follow the entries of expenditure for the year, which would include rent, if the farm were occupied by a tenant.)	
1830.	
Jan. 1st. To debts due by the farm	
To 5 per cent. on the value of live stock .	
To 5 per cent. on value of seed	
To 5 per cent. value of produce on hand -	
To balance being profit -	
£	

From Silliman's Journal.

PRAIRIES OF OHIO.

Although prairies have been almost universally admired, yet little has been said in relation to their special formation, or the geology by which they are distinguished from other lands. This is specially the case with the wet prairies, in the northern sections of Ohio. It is true their origin has given rise to various conjectures among geologists, but their structure has never been studied, with sufficient care, to enable them to arrive at correct conclusions. Their botany and zoology have met with more attention than their geology, but, even here, much still remains to be done.

The natural history of dry prairies has been less neglected than that of the wet. The magnificence of their scenery has invariably been the theme of the traveller, and the extent of their boundaries, and varieties of production, both animal and vegetable, have contributed largely to the embellishment of the pages of descriptive writers. The poet and the painter have also resorted to them, in search of objects to engage either the pen or the pencil. The wide unbroken plain, covered by a rich carpet of green, gold and purple; the tall grass waving in the summer breeze; the immense variety of flowers mingling their odors with the winds; the occasional clump of trees rising above the other vegetable growth; the distant herd of buffalo, cropping the grass or flying from the hunter, and the sun sinking amidst grass and flowers, must furnish a scene which can be but faintly described by either, but well worthy the genius of both. Late in the autumn, the fires which destroy the growth of the preceding year, in both wet and dry prairies, are frequently awfully sublime. When seen at night, from a distance, a chain of fire seems to extend, in every direction, as far as the eye can reach. The blaze often rises, in vast corruscations, far above the plane of the horizon. All beyond, presents to the imagination, a chaotic waste, while the earth and the heavens seem to be fast terminating in one grand conflagration. But we will leave the description of such scenery to the graphic pen which has already delinerated it, and proceed to the proposed detail of our observations, on some of the wet prairies in the northern sections of Ohio.

These marshy plains, though frequently quite extensive, are always much less so than many of the dry prairies of the western states. They are always surrounded by hills, which vary in height according to the extent of the prairie. Their bases contain large quantities of water-worn pebbles, with a few fragments of fresh-water shells, in a state of partial preservation. The soil of the prairie consists of a deep vegetable loam, covered by tall grass and flowering herbs, except where it is too wet to produce any thing but moss and other water plants. In every part of the prairie the tufts of grass and flowering plants rise three or four inches above the most inferior surface, which is covered, except in the dryest part of the season, with water to the depth of from two to six inches. These tufts, however, are so nearly connnected, that the water is never seen, except where the grass is cut, or thrown aside. The soil and productions gradually change, as we proceed from the edge to the interior of the grassy flat. Here we find a number of ponds, or small lakes, varying in size from a few rods to one or two miles in circumference. The largest of these ponds are well stored with fish, many of which differ but little, except in size, from those found in the northern lakes. The only woody plant that grows on the edges of the ponds, belongs to the *salix*, or willow tribe, except in a few instances, where they are thickly surrounded by a dense growth of alder, *(alnus serrulata.)* These ponds, however, from causes which will be presently noticed, are gradually disappearing, and their places being supplied by the surrounding prairie growth.

The bogs, or marshy flats, so abundant in wet prairies, constitute one of their most singular features. They are occasionally covered, either by a thin sod, or large tufts of grass, similar to those constituting the grassy surface of the prairie, only much larger. Upon attempting to walk over either of these, the ground beneath will shake for the distance of several rods. Sometimes they are very narrow; at others, they cover an area of many acres. Animals are often lost when attempting to cross these shaking bogs. Their depth must be great, for poles have been thrust into them thirty feet in a vertical direction, without reaching a hard bottom. Horses and cattle were frequently lost by the early setlers in such humid marshes. These are, also, generally disappearing, by being covered with a dense sod, which supports a luxuriant growth of grass, and other vegetables. Still it is dangerous to drive heavily laden wagons or carts over them, for the surface occasionally gives way, and the whole sinks into the dark mud below. An instance of this kind occurred, a few years since, in the district which I have been attempting to describe.

But the woody islands, which rise far above the tall grass, contribute much to the beauty of a wet prairie. Their timber consists of oaks, and other trees and shrubs, similar to those found on the neighboring elevations. Pebbles and shells, even more perfect than those imbedded at the base of the surrounding hills, are also abundant below the soil, at the termination or shore of the islands.

A stream of water passes either through those prairies, or in their immediate vicinity. When it overflows its banks, so as to cover the low grounds with water, the whole presents the appearance of a fresh-water lake, with a variety of small islands scattered over its surface.

Marshes, thickly set with willows, alders, and a great variety of flowering shrubs, principally of the rose kind, are sometimes abundant along the margins, or even in the central portions of wet prairies. Here water animals, such as the musk-rat, otter and mink, were once abundant, and are so still, except in the immediate neighborhood of settlements. The first of these animals appears to delight to dwell in villages, placed at some distance from each other, while they keep up a constant intercourse by travelling. This is done late in the evening. Their houses are usually six or eight feet in diameter, at the base, and about four feet in height, gradually rounded at the top in such manner as to turn the water in every direction. It is said, by most writers, that they build a new house every year; but this is not correct, for I have known them to occupy the same dwellings for several years in succession. I have counted fifty of these houses, in a shallow pond, within an area of one or two acres; and seen hundreds of their inhabitants playing in the evening, in one of their villages, apparently in the full enjoyment of all the pleasures of association. They always enter their houses by subterranean passages, which commence beneath the water some feet distant.

Beaver-dams have been abundant along the streams in the vicinity of these marshes, but their remnants only are now to be seen; the animal having fled, with the Indian and buffalo, far beyond the confines of civilization. It is singular that this animal always chose to construct artificial ponds, rather than occupy those already furnished by nature, though but a short distance from its adopted location.

The hills, bounding the wet prairies, which

have fallen under my notice, are composed chiefly of a blue dense sandstone, or *graywacke*, with little or no calcareous deposit, or impress of organic remains. The *alluvion* of prairies rests upon a blue carbonaceous clay, abounding in roots and trunks of trees, with other vegetable remains, scattered from ten to one hundred feet beneath the surface. Salt water has been obtained, in the vicinity of these prairies, at the depth of six or seven hundred feet; but I have never been advised of the strata through which the auger passed. The water was procured about three hundred feet below the level of Lake Erie, and the same distance beneath the bed of the Ohio, at the mouth of the Muskingum.

So much for a description of wet prairies: let us now turn our attention to their origin.

Without stopping to examine the various hypotheses which have been suggested from time to time, to explain the origin of wet prairies, the facts already mentioned would seem to indicate, that they were either the basins of lakes, or excavations in the beds of ancient rivers, filled by natural causes. The water-worn pebbles and fragments of shells, the animal and vegetable remains, and the small lakes already mentioned, are sufficient evidence that large quantities of water must, at some period or other, have existed between the elevations now enclosing the prairies. It is also worthy of remark, that bowlders and other fragments of primitive rock, are scattered over the neighboring hills, and along the margins of these prairies, while they have never been found upon their surface. It is said they are scattered over the wet prairies of Champaign county, Ohio, but if so, these are entirely different in character from the prairies I have attempted to describe. They must have been formed *upon* the bed of some ancient lake, after its waters had escaped, while these to which I have so often referred, were the offspring of a filling up of a former basin, by the *debris* of the adjacent elevations, assisted by the peat moss of their waters, and the timber and remains of animals brought into them by the streams. It is in this manner that the small lakes in the interior of wet prairies are now gradually disappearing. At first, the water leaves a kind of shaking bog, similar to those already mentioned, but this eventually loses its humid character, and presents a deep black mould, differing in no respect from that found elsewhere in the low lands. The woody islands, or many of them, at least, were once undoubtedly surrounded by water, which must have beat against their shores for a long time; for if this were not the case, the quartz pebbles could never have either reached their present locations, or been reduced to a rounded form. It certainly required much water, time and attrition, to perform so important a change. The pebbles could not have been driven over the prairie, for none such are found upon its surface. Blocks, or large bowlders of granite, have been detected, when boring, deep beneath a wet prairie soil. These must have been transported here at the time the same species were lodged upon the surface of the surrounding country. The basin of the prairie must also have been filled with water, at that period, otherwise they could not have descended as far beneath the surface.

But wet prairies do not remain such continually. Many of the causes which aided in their formation, are now contributing much towards their destruction. The *debris*, consisting of sand, gravel, and clay, of the higher lands, is gradually converting their borders into a sandy soil, followed by a growth of timber, and other vegetables, peculiar to the upper lands. At first the ligneous productions consist principally of a variety of hazel and oak, none of which attain a large size. This growth, however, soon gives place to another, which continues to extend until a dark forest has taken the place of grass and flowers.

Cultivation also contributes much to the destruction of prairies, by the introduction of grasses and plants essentially different from the wild growth. The enclosures, likewise, arrest the fires, alluded to in the beginning of this paper, and thus prevent the annual destruction of shrubs, and the small sprouts of arborous plants. When these fires are prevented from sweeping over the surface of wet prairies, for several years, they are soon covered by a dense growth of alder, which eventually gives place to the vegetables named in the former paragraph. This change, however, does not take place, until the soil has changed its character, by the introduction of sand and gravel from the surrounding elevations. This is effected rapidly after the hills and table lands are cultivated; for when the soil is broken, it is easily driven downwards by rains and running streams.

Thus the immense natural meadow; the residence of the beaver, the otter, and the water-rat; the place of grass and flowers, is reduced, by natural causes, to a dense forest, furnishing timber, and other materials in agriculture, and the arts. The basin of the lake, over which the Indian paddled his bark canoe, is filled, and its place known no more, except to the philosopher, who can read in the rocks, the pebbles, the sand, and the trees, the records of the past. The watery sheet has given place to farms and villages, and the sound of the hammer, the axe, and the bell, is heard in the valley which once echoed with the shouts of the aboriginal, blended with the wild notes of the water-fowl.

The streams which pass through these prairies, though often large, flow with but little current, in a very serpentine direction, through a dark alluvial soil which contains but few pebbles, and no large bowlders. In many instances, a large vegetable growth, similar to that found in the neighboring ponds, arises from the bottom of the stream. Their shores are more elevated than the surfaces of the adjacent marshes, or prairies, and hence they are thickly covered by trees of a superior growth. The stately white elms, so abundant along their immediate borders, contribute much to the formation of a beautiful landscape. Their trunks seem to be placed at regular distances from each other, while their long branches meet and coalesce so completely, that they form a most extensive natural arbor. Early in the spring, multitudes of squirrels resort to them, from the neighboring hills, in order to feast on the expanding buds. Before the country was thickly settled, and the beauties of nature defaced by the hand of art, herds of deer might often be seen feeding on the undergrowth of these bottoms. At this period but few logs were found upon the surface. Occasionally a large prostrate elm, or sycamore, upon which a pheasant sat and thumped away the morning, pointed out the spot where the brawny

squatter had feasted on wild honey, or labored to bring down a raccoon or a bear.

Wild fruits, especially plums, grapes, black and red haws, and black-berries, are abundant along the edges of wet prairies. In many places, in the vicinity of elevated lands, the ground is covered, for miles, with strawberries, but whether they are indigenous, or introduced by the very early settlers, I am unprepared to say. The blossoms of the crab, also, frequently fill the air, in the early spring months, with the most delicious odors. It is from these, together with the various other blossoms and flowers, that the wild bees chiefly obtain their honey. They usually store their sweets in the hollow limbs and trunks of the neighboring trees, where they sometimes accumulate immense quantities. But the most delicious fruit which grows in wet prairies, is the cranberry. The collection of this fruit furnishes occasion for pleasure parties of the young people, which are among the most agreeable of the rural diversions of the west.

Many of the wet prairies are more elevated than those already mentioned. They are, however, small, containing but few acres, and distant from streams of water. Still their formation appears to be the same, with those already described. When ditched, the peat, which they contain, becomes very dry during summer seasons. A farmer once called my attention to a small boggy or shaking prairie, which had been ditched two or three years previously: but when the grass and small brush were set on fire, to prepare the ground for cultivation, the surface ignited, and continued to burn for the principal part of the summer. When the fire ceased, he found he had a bed of earthy ashes, from three to eight feet in thickness, instead of the productive soil he anticipated.

From the Raleigh Register.

SECOND ANNUAL REPORT OF THE RALEIGH AND GASTON RAIL ROAD COMPANY.

In submitting to the stockholders the following report of their proceedings since the last annual meeting, the president and directors deem it not amiss, briefly to advert to the state of affairs and the condition of the work at that time. It will be seen on reference to the report then made, that the road had been located as far as Tar river, and the greater part placed under contract. From the severity of the winter, but little work had then been done. As soon, however, as the spring opened, the work was vigorously prosecuted, and we have the satisfaction of stating that, with a single exception, the contractors have thus far complied with their engagements. The grading of 48 miles of the road is now completed, with the exception of a few hundred yards, and the work executed in a manner highly creditable to the contractors and engineers entrusted with its supervision. The soil is admirably adapted to the construction of a rail-road; and the cuts are generally free from water. The banks on the first nine miles of the road, from Gaston to Littleton, having been thrown up a sufficient time to become firm, it was thought advisable to lay down the superstructure on this section at once; so that it is now ready for use, as soon as the bridge across the Roanoke shall be completed. On the remaining 38 miles, the timber has all been delivered and dressed, ready to be laid down as soon as the embankments shall have become sufficiently settled, from exposure to the winter's frost.

The bridge at Gaston, which had just been commenced at the last meeting, is now completed within a span and a half, and would have been ready for the cars on the first of January, but for our disappointment in receiving timber which had been contracted for and procured on the lower Roanoke; but, owing to the low water in the river, and the difficulty in obtaining means of transportation, it could not be brought up in time, notwithstanding every effort to do so. This difficulty is now removed, and the bridge will be speedily completed. The iron, which was ordered, has all arrived, and is ready to be laid; and we see no reason why the whole 48 miles should not be ready for transportation by the first of June, though experience has made us somewhat cautious in giving any pledges to the public on this subject.

On the road between Roanoke and Tar river, there are five depots, viz:—at Littleton; at Brown's, five miles north of Warrenton; at Lambkin's opposite Warrenton; at Twitty's; and at Henderson, about three miles south of the Chalk Level; all of which, with the water stations and wood houses, are nearly finished.

The land damages have, with one or two exceptions, been liquidated in the counties of Warren and Granville; but in Halifax, though proceedings have been instituted, the difficulty of procuring suitable commissioners to act, has, as yet, prevented their being adjusted. This has been increased, by the omission in our charter to provide compensation for the services of the commissioners. We hope, however, they will soon be settled, and that those who, for the purpose of enhancing their damages, have pretended such hostility to this work, will then cease their opposition. In Franklin and Wake, steps will be taken at the ensuing courts, to condemn the lands of those with whom we cannot effect compromises.

The line from Tar river, to Raleigh has been located. After crossing the river below Chavis' Ford, it runs by Presley Person's, near Winston and Kearney's store, crosses Cedar Creek, and the two Brandies, runs through Wake Forest, along by the Baptist Institute and Alston's store, crosses Neuse river, near Wm. B. Dunn's, thence by Robert Jeffreys', crosses Crabtree about 250 yards below Jones' bridge, thence crossing the stage road at the Pigeon House, it enters Raleigh in the rear of Thomas P. Devereux's, and terminates at Halifax street, in the ravine between Mr. Devereux's and the Eagle Hotel. For a more particular and minute description of this location, we beg to refer to the detailed report of the chief engineer, which accompanies this. Believing that the interest of the stockholders would be greatly promoted by the speedy completion of the road to Raleigh, and finding that contracts could be made on more favorable terms at that time than any subsequent period, immediately on the completion of the grading on the first division, it was determined to go on with the work. The whole line to Raleigh is now under contract, and the contractors have commenced operations. This course will, we hope, meet the unanimous approbation of the stockholders.

It was never contemplated or expected by any one acquainted with the work, that the sum originally subscribed would be sufficient to complete this undertaking; and it is now evident, that the whole capital of one million will be insufficient for that purpose. It will be necessary, therefore, for the stockholders, at the present meeting, to adopt some measure for the increase of the capital, to enable us to comply with our contracts.

As the scheme would be incomplete, were we now to stop short, and the value of the stock be thereby materially affected, we cannot doubt that they will adopt any practicable plan which can be devised for raising the means of carrying on the work. To effect this, three modes have suggested themselves. By the terms of our charter, the original subscribers are first entitled to take the residue of stock unsubscribed. The first plan then would be, to offer to apportion the remaining stock among the present solvent stockholders, according to the amount already held by them. This would, in some instances, operate unjustly and oppressively, as many may have made as large investments in the first instance as their means would enable them to do; besides, we think this could only be done by the unamimous vote and consent of the stockholders, and it is on that account further objectionable, as it would be difficult, if not impracticable, to obtain this. To comply, however, with the provisions of our charter, the offer can be made to the respective stockholders, who can then accept or reject it at their option.

The next and most obvious plan, is to re open books of subscription for filling up the amount unsubscribed. Had the condition of the country continued as prosperous and flourishing, and the facilities for obtaining money as great, as at the commencement of this work, we might calculate with certainty upon the success of this measure, and that the same anxiety to possess our stock, which characterized our first movements, would be again manifested; for nothing has occurred to diminish our confidence in the ultimate success of the undertaking. But owing to the sudden and unfortunate revulsion which has taken place in the pecuniary affairs of the country, (from causes unnecessary to be here alluded to,) stocks of every description have undergone a very considerable decline; and, from the difficulty of procuring money, are no longer sought for with the same avidity as formerly. Our largest capitalists find it inconvenient to meet their existing engagements, and those having the command of money have so many opportunities of making investments affording immediate and exorbitant profits, that but few can be found to take stock in incorporated companies, however flattering their prospects may be. From these causes we apprehend there may be some difficulty in obtaining subscriptions for the whole remaining stock. This can, however, be attempted, and in the event of its not succeeding, it is then recommended to the stockholders to vest the board of directors with authority to make a convertible loan, or loans, to the amount of the residue of the capital stock, and to pledge the property of the company for the payment thereof. This plan, if sanctioned by the stockholders, is believed to be more practicable than either of the others; for, while the scarcity of money is so great in the United States, it appears to be abundant in England, and capitalists there are seeking investments far less profitable than this would be. As soon as confidence in American credit shall be restored, which we are pleased to say is daily increasing, and a sufficient portion of our road shall be in operation to afford a guaranty for the loan and the payment of its interest, we have every assurance that it can be effected there, if not in this country; and we are confirmed in this belief by our knowledge of the fact that several rail-road companies in the United States have already negotiated loans in England to a considerable amount, none of them giving better security than we can offer. We would, therefore, recommend that the president and directors be instructed, in the first place, to receive additional subscriptions for stock to an amount, not exceeding in all one million of dollars; and, in the event of the whole not being subscribed, that they be authorised to negotiate loans convertible, or otherwise, as they may think proper, for such sum as may be required to increase the whole capital of the company to one million of dollars; and, for that purpose, that they be empowered to employ suitable agents. The interest of the stockholders, regarding them merely as such, the benefit to the country, and the whole success of the work, demand its extension, and we are therefore satisfied that the stockholders will adopt any means in their power to effect this.

A line of coaches commenced running between Gaston and Fayetteville during the last spring; and, although the change of times has caused a considerable reduction in the number of travellers, it has received a fair proportion of public patronage. From the experience gained from this, we are satisfied that the want of facilities is the only obstacle to the diversion of the greate. part of the southern travel along this route. These will be greatly increased by the completion of our road to Raleigh, and if two good lines of coaches shall then be established, the one leading south to Columbia and Augusta, and the other, westwardly to Salisbury, there to connect with the Tennessee and Piedmont lines, we have little doubt that the principal part of the southern and western travel will find its way to this road. It may not be irrelevant or improper here, to draw a comparison between the present travelled routes from the south and south-west to Baltimore, showing the difference in the distance by them respectively. Taking Milledgeville, Geo. as the starting point, the distance from that place to Baltimore, by the Piedmont, the most direct route, is 692 miles—the whole of which journey, as far as Potomac creek, is performed in coaches. The distance from Milledgeville, *via* Augusta, Columbia, Fayetteville, Raleigh, Petersburg, Richmond, Fredericksburg and Washington city to Baltimore, is 711 miles, or only nineteen miles farther than the other. Of this, upon the completion of our road to Raleigh, there will be 235 miles of rail-road, which will far more than counterbalance the increased distance; and even those choosing to travel on the Piedmont line, by diverging at Salisbury, (a distance of about 120 miles from Raleigh) may intersect our road here, when they will have a continuous line of rail road, with an increase of only 37 miles in distance. The distance by the third route, *via* Charleston, Wilmington, Halifax, Portsmouth, &c. to Baltimore, is 862 miles, being

170 miles greater than by the Piedmont, or nearest, 151 miles, than by the road *via* Raleigh. Should the contemplated scheme of connecting Raleigh with Columbia and Augusta, by rail road, be carried into effect, which we are satisfied must be done in the course of a few years, it will place this route beyond competition; and the stock of our road must become as valuable as any in the union.

In prosecution of this, and pursuant to the authority given by the stockholders at their last meeting, a reconnoissance of the route from Raleigh to Columbia was made by the chief engineer of this company, whose highly satisfactory report shows that a very favorable route may be obtained. Books of subscription for stock in the Raleigh and Columbia road were opened during the past year, and a large amount subscribed—the greater part in the city of Raleigh—but not sufficient to secure the charter. As we still regard the construction of this road of vital importance to the success of our own, it is thought proper to bring it again before the stockholders, that such measures may be adopted by them as they may deem advisable.

Whenever this road shall be commenced, we are assured that the legislature of South Carolina will, with their accustomed liberality and spirit of enterprise, incorporate a company for the further extension of the road to Columbia; and, we learn, that the Charleston and Cincinnati road has been located with a view to that connexion. We are still of opinion that the route originally contemplated through the counties of Chatham, Moore and Richmond, is the proper direction for this road, both as regards the directness of the communication, for the accommodation of the northern and southern travel, and the probability of its ultimate extension weswardly, so as to connect us with Salisbury and the whole western section of the state, for we cannot yet abandon the hope, that the citizens of this fertile section of our state, cut off as they are from all facilities for transportation to market for their varied and valuable products, will, ere long, find it to their interest to unite with us in accomplishing this object, so desirable to themselves, and tending so manifestly to the improvement of the internal condition of our state, and the developement of its vast resources. Ours appears to us now, the only feasible scheme; and although, heretofore, disappointed in our expectation of interesting them in our project, we are still disposed to extend to them the hand of good fellowship, and will most cheerfully unite in procuring for them at least one good outlet for their produce. This we shall be enabled to do, by diverging at Haywood, or some other suitable point in the county of Chatham, extending thence weswardly, along the borders of Randolph and Guilford, to the Yadkin, whence, if desirable, it can be continued so as to intersect the Charleston and Cincinnati road at some favorable point within the state.

Since the last annual meeting, the heavy expenditures incident to a work of this magnitude, and the rapidity of its progress, have compelled us to call largely upon the stockholders for contributions. Instalments of ten per cent, have been required to be paid on the first days of March, July, October, December, January and February, which, together with the amount previously paid, have produced up to the first of January, 1838, the sum of $406, 125 85.

Although the difficulties of the past year have caused some little delay in the collections, and produced some failures among the stockholders, yet upon the whole, we believe the payments have been generally made with more punctuality than to any other road now progressing. To relieve the stockholders, as far as possible, at a season when the pressure was greatest, a loan was made from the bank of the state, to whom the company is now indebted in the sum of $70,000, which is to be provided for and refunded out of the instalments now due, unless some other arrangement is made by the stockholders.

A detailed statement of our receipts and disbursements will be found appended to this report, to which we beg to refer. The accounts and vouchers have been examined by the committee appointed for that purpose, whose report is herewith submitted.

By order of the Board of Directors,
GEO. W. MORDECAI, *Prest.*

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PROCEEDINGS OF THE STOCKHOLDERS OF THE RALEIGH AND GASTON RAIL ROAD COMPANY.

At a general meeting of the stockholders of the Raleigh and Gaston rail road company, held at the banking-house of the state bank, on Monday, the 22nd of January, 1838, on motion of D. Camernon, esq. John D. Hawkins, esq. was called to the chair, and E. B. Freeman appointed secretary.

Upon its being ascertained that a majority of the stock was represented, the meeting proceeded to business.

The report of the president and directors, together with that of the chief engineer, were submitted, and, on motion of Chas. F. Osborne, esq. ordered to be received and printed, with the accompanying documents, under the direction of the president and directors.

The following resolutions were offered by C. F. Osborne, esq.

Resolved, That the president and directors be instructed to receive such subscriptions of stock in the Raleigh and Gaston rail road company, as may be offered; provided such subscriptions do not in all exceed one million of dollars.

2. *Resolved*, That in the event of the whole amount of the capital not being subscribed, the president and directors be authorized to negotiate a loan for the deficiency, (convertible or otherwise, as they may think proper,) on such terms as they may deem most advantageous to the interest of the stockholders; and that they be further empowered to pledge the property of the company for the guaranty of said loan, and the payment of its interest, and to employ suitable agents.

3. *Resolved*, That the proceedings of the president and directors, in letting out the remainder of the road to Raleigh, is unanimously approved, and that they be desired to prosecute the work as rapidly as possible, consistently with its durability and the interests of the stockholders.

4. *Resolved*, That the president and directors be requested to apply to the next session of the legislature of North Carolina, for an increase of

the capital stock of the company, to the amount of one million and a half of dollars, and for such other aid as they may deem most consistent with the interests of the stockholders.

5. *Resolved*, As the opinion of the stockholders, that it is of the greatest importance to the success of this work, that the road should be extended to Columbia, South Carolina, and that they will use their utmost efforts to insure its extension to the South Carolina line.

6. *Resolved*, That the report of the committee appointed to examine the accounts and vouchers of the president, be approved and adopted, and that he be directed to balance the books, pursuant to the recommendations of said committee.

7. *Resolved*, That in future the annual meeting of the stockholders be held on the first monday in June in each and every year.

Which were unanimously adopted.

The meeting then proceeded, on motion of Mr. Osborne, to the election of a president and five directors. Wm. Boylan and Samuel S. Downey were appointed to superintend the balloting.

The committee reported that the following persons were elected: Geo. W. Mordecai, president; Duncan Cameron, Wm. Boylan, Joseph W. Hawkins, Chas. Manly and Thos. P. Devereux, directors.

On motion of Duncan Cameron, esq. a committee consisting of Wm. Robards, Wm. Peace, and Alfred Jones, or a majority of them, was appointed to examine the accounts of the president, and report to the next annual meeting.

On motion of Mr. Garnett, the following resolution was adopted:

That we feel a lively interest in establishing a communication by rail road with the west, and invite the co-operation of our fellow-citizens of Salisbury and the adjacent country, in procuring a charter from the legislature, for that purpose.

The meeting then adjourned.

From the Maine Farmer.

USE OF SWAMP MUCK.

Mr. Holmes:—I have noticed in the 44th number of the present volume of the 'Maine Farmer,' that a friend wishes to know whether muck which is composed of decayed leaves, roots, and other vegetable matters, will do as a dressing for land without being previously mingled with animal manure?

As I have used much of the muck in years past, I will try and answer "from actual expenence." I hauled direct from the swamp, one winter, about 200 loads upon a piece of land of different qualities, varying from a muck, or dark black soil, to an open, porous, gravelly elevation. On the black soil, it has done nothing—the soil naturally abounded in muck. But on the gravelly elevation it has done much to enrich the soil. Its benefits vary much on different soils. I should not put it on wet land in any case—it is labor thrown away, without it is mixed with animal manure; and in that case, the manure will do as well without the muck.

I should be in favor of laying the muck in the barn or hog-yard for a season, for the purpose of destroying the weeds and seeds with which it abounds. I have found when I have hauled muck direct from the swamp on my lands, that I have introduced many of the wild grasses, and weeds that are hard to be subdued.

In conversation with one of my neighbors—a farmer who has had some experience in muck—he told me that when he commenced operations on the farm on which he now lives, that he ploughed a light dry piece of ground in the fall of the year; and being short of manure, he hauled what he had on half of the piece, and then went to the meadow and hauled muck on the other half, and in the spring following planted the piece to corn. He further says, that that part of the piece that was dressed with muck, produced as good corn, and little the best wheat—and held out as well for grass, as that dressed with the manure from the barn.

I will make an extract from an article in the 8th vol. of the 'N. E. Farmer,' (signed W. H., Catskill, N. Y., 1830,) page 27. The writer says, "last fall I carted several loads of muck on a knoll of loam, and put it in one heap, though I thing it would have been better to have dropped one load only in a place—(I thiuk so, too.) In the spring, prior to planting corn, the muck was spread, and ploughed under. The crop of corn, where the muck was spread, was large—I thought larger than where barn yard manure was put. A neighboring farmer has made use of muck for several years. The first year he thought it equal to barn yard manure, and its effects were perceivable a much longer time. The soil on which the muck was put, was a warm gravelly loam.

The muck was used by another neighboring farmer, for manuring corn in the hill, in the following manner: a row of each, alternately, one of muck, one of barn yard manure, and one of hog manure. He assured me the corn was much the best manured with the muck. The soil a sandy loam."

THO. PIERCE.

Readfield, Jan. 1838.

Extract from the Delaware Journal.

IMPROVEMENTS OF NEW JERSEY, AND PROSPECTS OF DELAWARE.

We mentioned in our paper of last week that the agricultural society of this county had, through its president, Philip Reybold, esq. received an invitation from several prominent and enterprising gentlemen of Salem to [visit] the marl pits and limestone quarries of that region, and also to see in the adjoining county of Gloucester, the celebrated Durham stock of Mr. Edward Tonkins. The compliment was properly appreciated by the society, and a committee appointed to represent it; and although the weather was unfortunately most unfavorable for the excursion, we learn that a respectable number of the committee were in attendance, among whom were Edward Tatnall, Dr. Thomson, and Joseph Tatnall of this city—Maj. Stockton of Newcastle, Philip Reybold, Anthony Higgins, and Philip Reybold, jr., of Red Lion Hundred. The committee was met on its arrival at Salem by Josiah Reeves, esq. of Alloways town, Mr. Cassby of Salem, and other gentlemen, and after spending a short time there—were by common consent handed over to the particular care and kindness of Mr. Reeves, who took them

all to his house, and of whose kind attentions and elegant hospitality, we have heard but one expression of opinion by the gentlemen who were the recipients of it. The whole of Friday was consumed in examining the marl pits about Woodstone, Mannington and Swedesborough, and paying a visit to Mr. Tonkins and his famous stock.

The rich specimens exhibited to us of the shell and green sand marl brought over by one of the committee, as also the limestone of Mannington quarries, which are in the immediate vicinity of the finest beds of marl—must make Salem one of the richest counties of the state, and the clay soil which abounds there, a fine wheat country; no better evidence was exhibited to the committee in this improving county, (to which nature has been so bountiful in natural manures) than was shown on the farms of Messrs. Reeves': lands which cost them but $4 per acre (and unimproved, was dear at that,) covered with cedar bushes and crab grass,* and producing nothing like good grass or grain—with the aid of *lime* and *marl*, are now yielding three tons of clover and timothy to the acre, with 25 bushels of wheat the past year—and corn, rye and other products in the same proportions. The same may be said of all the other lands there, improved in this way. No one without seeing, can imagine the contrast now made between the old sedge commons and the cultivated fields reclaimed from them—the increased value thus given to individual and national wealth, is most obvious and interesting. Specimens of Delaware marl such as were analyzed by Mr. Booth, state geologist, (from St. George's hundred,) were taken over by the committee and compared with the best qualities of Jersey marl—they appear very similar, and are no doubt equally enriching, if judiciously applied, being of the same great veins which cross each of those states and penetrate largely into Maryland—and containing by examination about the same fertilizing matter. We augur the best results to our agricultural interests of both states from this visit of practical and improving farmers to each other, and the good example set by New Jersey, will not be lost on those of Delaware, who are now boring and finding marl daily, in most of the lower parts of this county.

From the Southern Agriculturist.

THE VINE.

The necessity of diversifying our agricultural pursuits, and of the early developement of our resources, cannot be too earnestly or too frequently urged upon our readers. We have so long rated ourselves upon the value and importance of our cotton and rice, in the foreign and domestic commerce of the union, that we appear to believe we *monopolize* the growth of, and trade in, both those great staples, and to forget, that with the extension of the foreign production, the value of our own must be diminished. We lose sight of the fact, that the removal of our slaves, and other laborers, to Texas, will enhance the value of labor in the cotton and rice-growing states, and necessarily the cost of production. To meet this state of things, we cannot too soon direct our attention to the production of other articles, which will pay better, and bring into employment, the vast amount of free labor, which is now a mere tax. We allude to the thousands of white and colored males and females, who cannot undergo the hardships of the cotton or rice culture, but who are perfectly competent to the production of wine, silk, &c. If we do not soon bestir ourselves, we shall find our monopoly of cotton and rice all a dream, and, that in some other divisions of agricultural labor, we are at the distance post, while others are at the goal. The countries lately under the rule of Spain and Portugal, and now, almost in a state of anarchy, must ere long be tranquillized. Soon as this shall be done, agriculture will be encouraged, and so soon as those countries shall occupy the positions in agriculture and commerce, which nature has fitted them for, our main dependence, rice and cotton, will decline in value, and perhaps ruinously to many. A certain soil and climate, being necessary to the production of the fine long, or sea-island cottons, we do not refer to them, but to what are known as short, or uplands. Cotton is indigenous of many vast tracts of country south of the United States; of some, where the spring is early, and the fall late; of others, where frosts never fall, and consequently the yield to the hand will be greater than from the best lands in *any* section of the union. These peculiarities of location, will be likewise advantageous to rice, and it will be produced by whites, creoles, Indians and negroes, in large and small quantities, upon their swamp and tide lands. Like wheat, in our northern states and Europe, it will be sold rough, and in large or small parcels, to merchants, who will ship it to——perhaps *our own country*. We have ourselves, set the example of shipping "paddy," and it will not escape imitation, for we have taught our customers, rice is better, when transported in its rough state. In our opinion the time is not distant, when shipping clean rice to Europe, will be a novelty. In Texas, Mexico, and South America, we shall have formidable competitors in the growth of the staples we now rely on so much, and we think it but a prudent fore-cast, to engage in the production of substitutes in commerce, so that if need be, we may relinquish the culture of cotton or rice, and suffer nothing from doing so. Without a very material fall in the price of lands and negroes, we cannot grow either rice or cotton, so as to compete *successfully* with the people of those southern countries, when brought under well established governments. These views we are aware, some will insist, are visionary; but we think little is ventured when we say, "the reflecting" will perceive they must be realized.

These general remarks have been drawn from us by noticing the successful culture of the grape in the state of Ohio. We allude to an article in the Cincinnati 'Republican,' upon which the editor of the 'Horticultural Register' remarks, "it is from one of the most scientific and successful cultivators of the vine in the west, and will be read with profit by all those who feel an interest in the subject." As *we* of the south should be among those most interested, we republish the article entire, as the best mode of laying before our readers the views of a practical and fortunate grower of the vine.

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* Query—Hen's nest, or poverty grass?—Crab (or crop) grass in the growth of good and rich soils.—Ed. Far. Reg.

"The vintage this season has been later than usual, and the produce not abundant. Early in the season the vines promised as well as I have ever seen them, but our season has been unusually cool and wet, and one half our grapes dropped in the early part of it. My crop will fall a few barrels short of one hundred, but the quality promises to be good. From my own experience, I should discard the old doctrine, of allowing the grapes to shrivel before gathering, and coincide with recent French writers, who are of opinion that more is lost in the aroma, than is gained in the saccharine principle. The more so, as the latter can always be supplied, and equally good with that obtained by the shrivelling of the fruit. Decidedly the finest grapes of the season, was a small vineyard of half an acre, the property of Mr. Jacob Resor.

"This vineyard is on the Ohio river, four miles below the city, on the side of the hill, fully exposed to the south. This is the first year of their bearing, and the fourth season since planting. His superior success this season is principally owing to their being young vines, and the ground dry. In dry, warm seasons, even a north exposure will yield better. Heretofore we have planted no vine nearer than five feet from plant to plant each way; his are planted three by four. His grapes are the Catawba, Isabella, and Cape, (Schuylkill Muscadel.) The product of his half acre was twenty-five barrels of wine, of thirty gallons per barrel, being fifteen hundred gallons to the acre. In a recent work on the manufacture of wine, by Busby, he states that Mr. Ruinart, of Champaigne, one of the largest proprietors of vines in that region, informed him, that the largest yield with them was eleven hundred gallons per acre; yet his vines were only eight or nine inches apart one way, and six or seven inches the other.

"The vine with us is less subject to injury than in any part of France or Germany, in which the best wines are made. They also complain of the wines becoming acid and ropy, neither of which evils have I met with in my wines. I have discontinued the cultivation of the Isabella entirely. I have made a wine from the Catawba equal, and I believe superior to the best wines of the Rhine; but it ferments unequally, and I can never tell what the quality of my wine will be till spring. In one instance, last fall, I drew two barrels from the cask in which the grapes had been mashed at the same time, and placed them side by side in the wine cellar. The one was a brandy barrel, the other a wine barrel; the former appeared to be in a state of fermentation the whole winter, was dry, and not fine when racked last spring. The latter never fermented, was clear as amber, rich and sweet as the moment it was drawn from the cask. I bottled it, and it has now all the fixed air of champaigne, but I have kept it in an ante-room attached to my ice house, or it would have burst the bottles. The same is true of the wines of Xeres in Spain; till the fermentation is over, it is not known whether the wine will prove to be Sherry or Amontillado.

"I am cultivating some new native varieties of grape, that are entirely free from the hard pulp generally prevalent in our native grapes, and for the table quite equal to the foreign grape; I have not yet tested the quality of all of them for wine. I have one variety, resembling the Noiren at Burgundy, that promises to make a superior wine, both red and white, but its produce will be comparatively small. The most celebrated of the Madeira wine merchants was recently in our city, when a bottle of these wines (red and white) was set before him, together with two bottles of Madeira, very old, of my own importing, red (Tinto) and white. No intimation was given that either was domestic, but a gentleman at the table requested him to select the best; he decided in favor of the domestic. The domestic wines were new, and I cannot say that I coincided with him in opinion, but I have known others, much better judges than myself, agree with him. The Cape always makes a fair wine, and should have brandy added in the spring—it is usual in all Madeira wines. It greatly improves by age, and resembles Madeira. At Vevay, this grape is always fermented in the skin, and a red wine made from it, which in my opinion is inferior to the white. The day is not far distant, when the banks of the Ohio will rival the rivers of France and Germany, in the quantity and quality of their wines. But after an experience of twenty-five years, and a waste of time and money in the cultivation of a great variety of foreign grapes, they confine themselves to American varieties, and the producing of new varieties from their seed.

N. LONGWORTH.

Cincinnati, Oct. 20th, 1837."

We are not a little pleased with the success of Mr. Longworth, as it may induce others, and we trust some even in this state, to turn their attention to growing the vine. Vineyards afford profitable employment to young, and feeble people, who would most generally be a burthen to their parents or owners, were not some light employment provided for them. It appears, too, the native grape is preferred, after a waste of much money, and "twenty-five years experience." This again is encouraging, and we hope will not be forgotten. A very large vineyard can be attended properly by a very few hands, ordinary hands too, till the vintage, when a greater numerical force will be required, to gather and cull the fruit. We refer all who are inquisitive on this subject, to volume the 10th of this work. It is there stated, the sixth of an acre produced 528 gallons—"a most enormous crop," as Mr. Herbemont says, but undoubtedly made, as no one acquainted with that gentleman will question his statement.*

Mr. H. readily obtains two dollars for every gallon of wine he makes, and his wines (red and white) are very good; but as he does not use brandy (but fermentation only) to give them body, we are unable to express an opinion as to how well, or long they will keep. We will take it upon ourselves to say, Mr. H. will cheerfully impart the lessons of experience, to any one desirous of profiting by them. We would seriously inquire of the most fortunate planters of rice or cotton—which of them ever did or can make, from the best land and upon the most approved system of culture, *fifteen hundred dollars from one acre?* Not one! Yet that sum (at only a dollar per gallon) is the produce of an acre of *vine* on the Ohio

* A full account of this crop was communicated by Mr. Herbemont, and published in the Farmers' Register at page 379 of this volume.—ED. FAR. REG.

—and of less than the *fourth* of an acre in our own state. The *Congaree* beats the *Ohio!* What will not *careful* culture do? *We* do not know—and pause for the answer.

For the Farmers' Register.

MISCELLANEOUS REMARKS ON PRACTICAL AGRICULTURE.

(Continued from page 668.)

Manure, and its application.—The price and character of labor in this country.

The inexperienced farmer, ambitious, perhaps, to excel in his new vocation, and solicitous to obtain information, reads with avidity the works of Sir John Sinclair, Arthur Young, and other celebrated, though *theoretical* British agriculturists, and is apt to adopt a system predicated upon their lucubrations—one ruinous in our country, because neither adapted to our climate nor our high labor. Let two facts ever be presented in prominent relief to the Virginia agriculturist, in every survey he may make upon his farm, or estimate of the probable fate of untried expedients. First, that ours is a dry climate; secondly, that the price of labor is extravagantly high, whether considered in reference to the charges of white hirelings, or to capital invested in purchase of slaves. Whereas, in England the climate is humid, and labor comparatively cheap. A system which would operate profitably in the latter country, might prove highly injurious here. The difference of climate, then, will induce a prudent man, to avoid, or abandon, the wasteful use of manure for top-dressing, while if he rightly counts the cost, he will also shun the erection of ingenious sheds, expensive stercoraries, and all the quackery of absurd, compounded mixtures of manures, as utterly unfitted to our means, the enormous charge of labor, and to every practical plan of profit.

In consequence of our burning suns and arid soils, we must continually guard against the evaporation of manures, if we look to manuring as a part of our system of farming. The most common cause of loss is by the exhalation of its most valuable ingredients; and in the absence of much science, or experience, one would think the first blush of common sense would admonish us that by spreading it thinly over a large surface, exposed to the sun and wind, the escape of the volatile matter of manure was invited. The loss becomes instantaneous, as it is almost entire. Exceptions exist, growing out of the different characters of manures, which may recommend its use in this way. Liquid or semi-liquid manures, which are immediately absorbed by the ground, and act powerfully, may be thus applied, or leached ashes, or gypsum. Lime or fresh ashes, in any quantity, are too caustic for top dressing. When applied in that way in England, where an unclouded day is scarcely known, the frequent showers which fall, neutralize their acrid properties and they act advantageously. By incorporating them with the soil, the natural humidity of the earth, effects that in the process of time which is speedily consummated in England, Scotland, and Holland, by the moisture of climate. But in the form of manure most frequently used—a form which I would recommend, a half decomposed state—the kind spirit of the manure (if I may so speak) is just held long enough in suspense near the surface to take wings and fly away.

If I have any credit as a farmer, it is for the quantity of manure which I annually make and apply; and I do without hesitation deprecate the practice of top dressing, as scarcely renumerating the farmer for the expense, and as on one involving a loss of three-fourths of the manure. I have tried it frequently, yielding to the opinion of those around me, for it has its advocates, and I can safely say I have never observed a very perceptible effect except upon the growing crop to which it was applied. Nay more, I am not certain that injury did not sometimes result from its application to the wheat, from the number of flies and insects of various kinds which it would collect the first warm days of spring, which would prey upon and deposit their eggs in the tender plants of the grain. From the mode I pursue, the land is benefited six or seven years. 1st. I haul out in the spring of the year the manure of the corn-stalks and litter of my farm-yard in a putrescent state, which I plough under for my corn. Coarse as it may be, I find it greatly stimulates the growth of the corn. In the fall of the year, when I cultivate this same ground in wheat, I find this manure thoroughly decomposed and friable, and it acts well upon my wheat, and several succeeding crops of grass &c. 2d. On my summer fallows, the manure is hauled when it is better rotted: it is thrown in heaps, say about 20 loads to the acre, and hands are employed to spread it just before stirring it in. The wheat being afterwards shovelled in, the manure is pretty well blended with the soil, and the land remains in good tilth for years. So far from top dressing, all my care is directed to put it under the surface, as quick as possible.

Having adverted, to the dissimilarity of England and this country, in respect to climate, and labor, and the inappositeness of the same system to both, let us not be discouraged by the apparent disadvantages of our agricultural condition. We have an infinitude of means to collect masses of manures and to collect them cheaply, not within the reach of the English farmers, and that too without manufactories of bone powder, clay kilns, Parisian poudrette, or laborious scraping together of rags, feathers, hair, ant-hills, rabbit and pigeons' offal. Indian corn is an untiring agent in the formation of manure when properly directed. John Taylor, through wielding the pen of an enthusiast upon the subject of corn culture, did not say too much in its favor, when he regarded it as a prolific source of manure. Considering it as I do, an exhausting crop, even under his four-shift system, nevertheless the recuperative powers of the manure manufactured from it, counterbalance the evils of its impoverishing nature—pre-supposing however, that a judicious use is made of it. When I see then, as I frequently do, in the valley of Virginia, where tillage in the main is superior to many other sections, corn-stalks left standing in the field, the whole winter, drying and washing and cumbering the ground when cut down in March, I unvoluntarily indulge in the soliloquy of Poor Richard—"that farmer does not work it right." The loss of fodder and manure thus wasted, under different management, would change the aspect, and treble the produce of a farm. Nor is there any saving of labor if the ground is to be

cultivated. Compare the wretched and depleting system of pulling off blades, (those conduits to the nourishment of corn) when the corn is in an immature state, afterwards topping it, then cutting off the stalks in the winter, with the one summary operation of cutting corn, tops, blades and all; and in reference to mere labor, the scale is in favor of the latter practice.

The labor of one hand ought to cultivate 20 acres of corn, which on an average will make 60 wagon loads of litter; and as it trebles itself when well managed in the farm pen, we have 180 loads of manure from 20 acres, after feeding horses and cattle, on terms cheaper than a transatlantic farmer can obtain. We can rival him in this way. We could not afford however, to send 12 miles for a load of manure, and purchase it at $3 a load, as it is said some of the English farmers do in London; because the cost of manuring one acre, would purchase so much first-rate land in this country. It would be bad economy in us, with the scarcity and dearness of our labor, to prepare oil cakes for our cattle and our land, because they would cost more than it would come to. We could illy afford to send to the fields of Waterloo, to buy dead mens' bones, to grind to powder, to enrich our land; but we might afford to send to Petersburg and Richmond and buy a load of manure at 25 or 30 cents, which we are told some of the neighboring farmers omit to do. The beneficial use and the cost of obtaining marl in the tide-water counties, have received a masterly demonstration, leaving me nothing to say relative to that great fertilizer.

In England, a redundant capital and population search means for their employment. In this country our wits are active in the employment of means to obtain both capital and labor. The true policy to pursue under circumstances of this discrepancy of condition, is not susceptible of mathematical accuracy. One thing is apparent, that general maxims are too frequently laid down without attending to exceptions.

When therefore, Adam Smith, says that white labor is the cheapest, we must look to it as one among a thousand abstractions in political economy, which will not apply to our country, at the present practice. The converse may be approved as the truth—that in all southern colonies, or new countries where the climate suits the negro constitution, black slave labor is not only the cheapest, but the only one we can rely upon at all for many years to come. It is foreign from my intention, sir, to employ my humble means to write a political essay. Let those undertake it, whose able effusions would command public interest. If I can throw together a few practical thoughts, however, imperfect the manner, which will prove useful, I shall have accomplished my design.

I will not undertake them, to say, or gainsay, that slavery is a political or moral evil, or whether it is condemned or approved in holy writ; though it may be incidentally remarked that the purest state of society which ever did exist, or probably ever will exist in any age or country, was, as we believe, some half century ago in old Virginia, previous to the discontent, consequent upon abolitionism had crept into our domestic police, or before an *alien* contact had infused a baneful poison into the pulpit, the press, the bar, and legislative halls of our southern country. The former was a state of patriarchal simplicity, when the proprietor of the soil, elevated above temptation, cultivated all the milder virtues, and his *bondmen* lived in peace and comfort around him, with minds unvexed by cares, and unseduced by phantoms of liberty—now conjured up by fanatics and knaves, in the polluted atmosphere of the present times.

Many individuals in this section of the state, were once lifted up by this whirlwind raised by northern emancipationists, and in their efforts to place themselves in a position where they could let themselves down in safety, and submit with becoming resignation to what appeared inevitable necessity—they commenced a system of gradually divesting themselves of their slaves, and substituting white laborers. In the northern and wheat growing counties of Virginia, some years ago, we thought the spirit of the times pointed to sectional emancipation at least; and in the absence of any apprehension of legal coercion, the moral force of opinion, and a conjunction of circumstances, induced calculations of profit and loss, which resulted in this belief, that a negro man, who would command $1,000 or $1,500 in Mississippi or Alabama, could not be advantageously employed in raising wheat. Well, sir, we tried the change; I among others—*hinc illæ lachrymæ!* We employed Tom, Dick, and Harry, all white freemen, and what was the result?—Excuse a familiar illustration. Tom was detected in trafficking with the remaining negroes; Dick, a bolder rascal, would pilfer himself, and Harry, a good natured honest fellow, would be drunk nine hours, and work one! We were forced to the conclusion, that these may make excellent political

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* * * but that they were very inefficient laborers.

We may speculate as much as we please about human perfectibility, and indulge a thousand Utopian dreams, that honesty belongs to no one condition in life; that in the absence of education, moral training, and good breeding, a fine honest character may be formed; but the plain truth cannot be disguised, that the vagrant laborer employed upon our farms, is, three times out of four, worthless, absolutely unqualifiedly worthless. Worthy exceptions certainly exist. The late Mr. William Wirt tried the experiment with German redemptioners, in Florida, and his was a failure. A respectable gentleman in Richmond, Mr. ———, tried it on his farm, near City Point, if not misinformed, with the same ill success; and from the recent 'Report' of the patriotic president of the James river improvement, we may glean a few thoughts about the blessings of absconding freemen. I have frequently conversed with the hardy yeoman of Ohio, Indiana, Illinois, when an eye witness to their rural management, and in reference to my inquiries about their labor, there was but one answer. "We can safely rely upon ourselves, and the labor of our sons; but the relation between our hirelings and ourselves, involves us in perpetual difficulty. They frequently charge two prices for one day's work, and work but half a day—take offence at trifles, are rude in their manners at table, indelicate sometimes in their conversation, before our wives and daughters, run off at times of pinching need, occasionally finding it convenient to take something which does not belong to

them." These are the men who are dignified with the misnomer of the *productive class*—rather drones *fruges consumere nati.*

Far be it from me, to disparage the thrifty mechanic of our country, the meritorious artificer of his own fortune; or, the humble farmer, who with his own labor, or the assistance of his sons, cultivates his 20 or 100 acres of ground. These are, in the main, valuable and worthy citizens. But I find if fortune favors one of this class, and by dint of labor and good management, he acquires an independency, although enured to toil himself, he soon becomes a slave-holder. One of the most worthy and wealthy men of this country, Mr. John Kerfoot, commenced life, as he told me himself, on a small rented farm, a few miles from me. "I began" said he "with two hands—here they are," presenting those members of his own. This is a standing joke with our old friend. He has now acquired a fortune variously estimated from $100 to $120,000. But to the point aimed at in this example. He employs slave labor, and carries what may be pronounced a prejudice so far, that he declares he would drive off a white overseer from his plantation. Another example. Mr. Isaac Hollinsworth of this county, of the estimable society of Friends, commenced life as a needy stone-mason. He is now worth not less than $100,000, accumulated by milling and farming. He would scout the idea of depending on white laborers on his estate. If, therefore, we, of the northern counties of the valley, into which there is a constant influx of Pennsylvanians, native Germans and Irishmen, have experienced the evils of white labor, *a fortiori*, our lowland brethren could not tolerate them.

There is to the common laborer in this country every temptation to idleness, in lieu of encouragement to industry, in subordinate employments. How can it be expected that he will remain stationary with his employer at $100 or $150 a year, when for twenty, he can buy an old horse and second-hand cart, or steal them, and after begging his way to Illinois or Wisconsin, can *squat* on a quarter section of land, and after a little while, with force of arms, assert a pre-emption right, which some demagogue, anxious to obtain his vote, will recommend shall be secured to him. And there, in a semi-barbarous state, with rifle in hand, he roams the wilderness in quest of game. This life has more sweets for him, than hard delving on a farm, amidst a refined society. It needs but little intercourse with our border people to be convinced of the truth of the observation of some philosopher, that there is in man, a much stronger proclivity to savage life, than to ascend the hill which conducts to refinement. *Facilis descensus Averni.* If it were not folly to wish for any thing, the attainment of which is physically impossible, we of the Atlantic states might desire a natural boundary, three hundred miles west of the Mississippi river more impregnable than the interminable expanse of prairie, which the present Judge Breckenridge supposes would limit the white man's settlements. When in the course of time, the intermediate space shall have been filled, and so soon as the conviction is forced on every mind, that Providence has been as beneficent to Virginia as to any part of his creation, then the refluent current of general prosperity may flow upon our desolate fields, and the labor of white men renovate their fertility.

This *migratory* character of our people, is a deadly foe to improved agriculture! A *stationary* population like that of England, feels a deeper interest in the improvement of their farms. The father fixes his domicil, plants his hedges, improves his parks, and throws around every object the utmost beauty of artificial scenery, and natural improvement. He is tied to the spot. He regards it as a home for his sons, and children of countless generations. By his descendants every object is regarded with filial veneration. Dear and early associations are connected with every time-honored oak, and building, and field. They find "tongues in trees, books in the running brooks, sermons in stones, good in every thing." These feelings, and sentiments operating from farm to farm—extended to every hamlet and village—is one of the main springs of England's agricultural superiority.

There is here, the same principle of good and evil which pervades the world. Nay more, there is not in Christendom, a more intelligent, enterprising, and daring people, than the inhabitants of the United States. Their superior intelligence springs from the unshackled liberty of the press—the universal diffusion of newspaper information, and their active commercial and trading habits. This weight will promote the cause of agricultural improvement; but their other qualities, speculating enterprise, and locomotive recklessness, are unfriendly to a system of persevering and improving tillage. It is obvious that no man will take the same care of his farm, when he thinks it probable he may seek his fortune, or his children inevitably will, in the broad expanse of the west.

Whither do these speculations conduct us? To what practical issue, deduced from the subject? To this, at least; we must be content with our slave labor for the present—simplify our farming operations, to suit their inferior intellectual condition, and avoid that complicated and expensive machinery of agriculture, which may be adapted to the state of things abroad. This simplicity is perfectly consistent with a vigorous plan of improvement. So long as we have slaves among us, observe towards them, an exact discipline, in unison with a spirit of generous humanity. Their condition and our own may be much meliorated by assisting the colonization cause in the removal of that incubus, the free colored population. Perhaps in the course of a century, when every avenue of speculation or adventure is filled, and a necessary *division of labor* is super-induced—the maxim of Adam Smith, may be verified, and white labor be profitably employed. The same necessity which now exists in Great Britain will then stimulate faithful occupation here, and certificate of character invite employment. Until then we must make the most of our situation. We need not encourage idleness among our young farmers, because we have negroes and overseers to depend on. Teach those who are designed for this most useful and healthful profession, to labor occasionally themselves. Make them acquainted with the details of agriculture. They will then be better judges of the exact duty of each slave. And he who, is not only a master of a general system on an enlarged scale, but makes himself acquainted with all minor points, down to the names of every part of his ploughs, gearing, all his farming implements and other minutiæ, operates to a better advantage.

I am sensible of having extended one branch of the subject proposed, to a length which leaves the other short of its legitimate proportions. I shall, therefore, with your leave, resume it at a future day, and detail various experiments with manures, testing their beneficial application and relative qualities.

A FREDERICK FARMER.

ECONOMY IN FUEL, &c.

To the Editor of the Farmers' Register.

Montgomery county, Md. Jan. 22d, 1838.

Dear Sir—Having a little leisure, and feeling disposed to make a small return for the many useful hints that I have derived from your valuable publication, I am induced to offer the result of an experiment made a few years since, with a view to the greater comfort and better accommodation of my servants, and the economy of fuel, time, and labor.

I am aware that I shall be met at the onset with an objection, too common with the farming community, to all improvements, "that they can't afford it;" but having been taught to believe, that economy consists in judicious expenditure, and that time saved was money gained, I was induced about three years since, to make an improvement at an expense of $500, that has more than realized my most sanguine expectations. It consists of a substancial, well built stone house, in size 36 by 18 feet, a story and a half high, with a kitchen attached, 18 feet square; the whole covered with the best cypress shingles. The lower story of the main house, which is appropriated to my farm hands (in number eight men and boys) has a plank floor, sufficiently elevated to prevent any dampness arising—and is divided into a large room in the centre, with two large windows furnished with glass, and two doors, one leading immediately into the kitchen. In this there is a large ten-plate stove, a table and benches; here they eat their meals; do any little in-door work in bad weather; and here they may comfortably work for themselves at night, if they feel disposed. On either side of the large room are two small rooms, with a window in each, intended as bed rooms, and to each two servants, one of these is allotted. The half story is all in one room, with a window in one end, and a door in the other, with steps on the outside, so that it has no communication with the servants' apartment. This I use as a store room. Being perfectly tight, the heat communicated from the stove below, has enabled me for the last two extremely cold winters, to keep apples and any vegetables, however, delicate and tender, from the slightest injury from frost. The convenience and accomodation furnished by this room alone, I estimate at thirty dollars, the interest on the whole expenditure. The kitchen, which is appropriated exclusively to the cook and her children, is but one story high, a bed room within it, and an open fire place. It is her business to cook the meals of the other hands, and have them ready on the table at fixed hours; to sweep and clean their house, and wash and mend their clothes; and, when not so employed, to spin, knit or sow, so that she is always about the house to take take care, and guard against accidents. In cooking their meals, the only restriction enforced, is against waste. Every day, for dinner, they have as much meat, and as many vegetables throughout the year, cabbage, potatoes, or beans, as they can eat. Fish without limit, as to number, for breakfast and supper, with an abundance of milk in the summer season, and cider in the fall and winter, when furnished by an extensive orchard, which seldom fails. There is no allowance of bread. Each hand is furnished in the month of November, with a suit of substantial home-made fulled cloth-stockings, and a pair of the best double-soled shoes. In the summer, with two suits of linen; blankets, hats, &c. and in return, I expect a faithful day's work, between sun and sun—never requiring them to work after sun-down at any season of the year. Comfortable servitude, I should say, for an abolitionist. But to return to the economy of the expenditure. It will be recollected, that I value the use, or rent, if you please so to term it, of the store room at thirty dollars, the interest of the expenditure. Having an extensive orchard, in the preservation of apples alone, I should more than realize this amount, independent of the other conveniences it affords. The interest being annually paid, the increased value of the farm, by such an improvement, might be considered a valuable investment. But I am fully convinced, by the experience of three winters, that the economy in fuel, time and labor, will, in less than ten years, more than reimburse the whole expenditure. The house being perfectly tight, and furnished with glass lights, leaves no necessity for open doors, and other openings for the admission of light; the substitution of a stove for an open fire-place, diminishes the consumption of fuel very considerably; and the two combined have, I am satisfied, reduced it one half. With me, and I have no doubt, it is the case with many others, the consumption of wood alone, has become an important consideration. But with all who value time and labor, the saving must be manifest and important. As to an objection that I had heard stated, and may be again urged, against close houses and stoves for servants, as rendering them more liable to colds and other diseases—my experience for the last three years has proved that in this instance it is wholly without foundation. My servants were never more healthy; and from their own declaration, were never half so comfortable.

The great error in the southern system of farming, I have long since been satisfied consists, Mr. Editor, in an undue estimate of the value of time and labor, and the want of proper fixtures with a view to its econmy. The log cabins which prevail in a majority of the southern plantations appear to have been constructed expressly with a view to the consumption of fuel, and the occupation of time and labor in providing it. At this season of the year, the whole force of the farm, both man and beast, is in the woods, perhaps detracting from its value by every tree they remove; and, in being necessarily abstracted from the improvement of that portion which has been too long neglected, bringing poverty and dismay upon the proprietor of the whole. Upon a large estate, the time and labor saved by a reduction of one half the fuel they now consume, if applied to the collection of materials for manure, of which there are few that do not abound in some description or other, and its

judicious application, would, by its increased productions in a very few years, more than reimburse any necessary expenditure; besides giving an increased value to the property—which every proprietor should study to promote. In those sections in which marl abounds, many are, doubtless, prevented from using it as extensively as they would wish from their inability to withdraw, from using this all absorbing occupation of hauling wood, the force necessary to its removal. In hauling stone for stone fencing, grubbing, cleansing, and reclaiming wastes; and in various other occupations adapted to the present season, the same difficulty presents itself to their accomplishment. In the plan recommended for its partial removal, I speak confidently, upon the experience of three winters, in declaring that my gain has been at least one half, both in fuel, time, and labor.

From the Mechanics' Register.

HOT BLAST.

"A Founder," in the London Mining Journal objects to "Patent Hot Blast" that the pig-iron is sadly deficient in point of strength, compared with pig-iron made in the *good old way;* that a cupola man can (seemingly with ease) take up a No. 1 "Patent Hot Blast" foundry pig, and break it across his knee; that in charging for a casting of five tons weight, for instance, we find it necessary to charge with six tons, whereas five tons twelve and a half cwt. of cold blast pig used to be quite sufficient; that all the founders have been obliged to increase the size of all patterns for castings that are likely to be subjected to much torsion or friction, since the use of the patent has become general in this country. That it has been a valuable discovery to the patentees and iron masters can never be doubted. But it still remains to be shown where and how the public have been benefited by the invention. And he inquires what has become of the *obdurate toughness* of the genuine Scottish cold-blast pigs.

Another correspondent states that the pig-iron obtained from the use of anthracite coal, by Crane's process, is not at all weakened by hot blast, but is better calculated for the founder's use than any he had seen—that beams cast from this iron of the same pattern with others from coke iron No. 1 had twenty per cent. the advantage. The reason, he says, why pig-iron smelted with anthracite is not weakened by the hot blast is the great quantity of carbon it contains. It is put into the furnace as it comes from the mine (not being cokeable) and being of a ponderous and compact nature, the cold blast could not penetrate as in the case of coke or charcoal.

G.

From the Farmer's Cabinet.

METHOD OF CONVERTING VEGETABLE MATTER INTO MANURE.

Much has been said of late on the subject of converting leaves and other vegetables into manure. That leaves and other vegetable substances can be rendered of immense value to the farmer, by their conversion into manure, the experience of many has fully demonstrated. The following plan was recommend some years since, by H. Brown, esq. a celebrated chemist, who stated in a paper presented to the "Society for the encouragement of Arts," &c. that he had found from numerous trials, made for several years in succession, by many of his friends, as well as by himself, the very great utility of the composition, as well as its cheapness, with the capability of its being made in any situation, and in any quantity. The mode of making it is as simple as it will be found productive. It is nothing more than green vegetable matter decomposed by quick or fresh burnt lime. Upon a layer of vegetable matter, about a foot thick, a very thin layer of lime, beat small, is to be laid; and so on, vegetable matter, and then lime, alternately. After they have been put together a few hours, the decomposition will begin to take place—and, unless prevented by a few sods, or a forkful of vegetables at hand, the mixture will break out into a blaze, which must, at all events, be avoided. In about twenty-four hours, the process will be complete, and you will have a quantity of ashes to lay on your land any time you wish. Any and all sorts of vegetables, and weeds of every description, if used green, will answer the purpose. They will doubly serve the farmer, as they will not only be got at a small expense, but will in process of time render his farm far more valuable by depriving it of all noisome weeds. Dr. Brown states that he made a calculation with clover, grown for the purpose, and that one acre, at a single cutting, when decomposed by the above process, yielded a sufficient quantity of ashes to manure four acres. He states that the vegetables should be used as soon after they are cut as possible, and the lime as fresh from the kiln as the distance will allow. It appears that on these two circumstances mainly depends the goodness of the composition. We think this plan is worthy of further experiments, and we should be happy to communicate to the public the result of any trials made for the purpose of testing its utility.

From the Vermont Telegraph.

LIME AS A MANURE FOR POTATOES.

Something have already been said and done, on the subject of using lime in raising potatoes. The experience of the friend whose name is attached to the statement below, goes to recommend at least an experiment. Will not the quality of potatoes be improved by the use of lime, as well as the quantity increased?

Waterford, Jan. 1*st*, 1838.

Respecting the use of lime in raising potatoes. I can make no accurate statement as the result of my experiment, as I was not at home when my hands commenced digging those that were limed; but as near as I can calculate I obtained something like 100 bushels more for making use of about six bushels of slacked lime, in the following manner: I had about half a pint of lime placed in the hill, and had the potatoes dropped on it, and pressed them down gently with the foot before covering. I was led to try the experiment by seeing the effect produced by some lime that had been used in a tannery, being put into the hills of some potatoes.

JOHN IDE.

From the Maine Farmer.

SWAMP MUCK.

We have had several conversations with the farmers in our vicinity relative to the query which we made a few numbers back concerning the use of swamp muck as a manure.

Mr. Z. A. Merrow informs us that he has taken this substance out in the fall and used it in its natural state in the spring as a manure for potatoes. The result of the experiment was that the muck appeared to be nearly or quite as good for this purpose as coarse unfermented manure. He does not suppose that it will last so long.

Mr. Day, formerly of Leeds, corroborates the above statement, he having used it for manuring the potato crop in the same manner. The statement of Mr. Metcalf, respecting his ruta baga crop published in this day's paper, is also, in favor of the use of this article.

REMARKS ON THE SCHEME OF THE EASTERN SHORE RAILWAY.

To the Editor of the Farmers' Register.

I have read with some attention the report of Colonel Kearney, the principal engineer on the Eastern Shore rail road. He very truly gives a favorable account of the capabilities of the location. The site is on a level sandy country, relieved with marshes, with few hills to encounter, and no mountains to subdue. The engineer makes the distance from the Tangier sound, to a point in the Susquehanna and Wilmington rail road, near Elkton, 118¼ miles, and estimates the cost at $1,005,538. From the Tangier sound, it is proposed, by steam boats, to connect it, at Portsmouth, with the rail roads now in progress to Charleston. I charge no bad faith on the engineer's estimates. I have no doubt, having measured the distance, and assumed his data, that he worked the sum fairly, and has given the true result. I greatly admire, in the progress of science, the exactness to which civil engineers have arrived in their estimates. They are not now in the rear of the military engineers in the reign of Louis XIV, when Vauban and his compeers could calculate to a fraction the cost of the cannon, mortars, bombs and gunpowder, necessary to storm a fortified city. Very honest estimates of public works, often prove very wide of the practical expenditure. Of this, Maryland, of late, has had some costly instruction. The Potomac and Ohio canal company, finding themselves at a dead stop, near Harper's Ferry, for want of funds, in 1835, applied to the legislature for a loan of two millions of dollars, which they had ascertained, by calculation, would carry them to Cumberland, the region of the coal mines, (anthracite and bituminous,) by which the whole country, for ages, would be kept warm and comfortable; and they represented that the state had full security for the money in the anticipated profits of the canal. The money was voted, in full confidence. Before the end of the year, it was discovered that an error had been made in the estimate, by three millions, and the company appeared before the legislature, at the next session, magnanimously admitting their error, and stating, at the same time, that if this mistake in calculation was not corrected by advancing the three millions, that the other two would be lost to the state. This argument, though very cogent, failed to convince a majority of the members, and a bill was got up by some adroit hands, and being well baited by grants of money to other interests, and among them, to an Eastern Shore rail road, was passed after a hard struggle. I have lately learnt, from a respectable source, that there is still an error in the estimate by one million, which must necessarily be supplied by the state. Believing that the Eastern Shore rail road can be of no general advantage to the country, and of no benefit to the people of the Eastern Shore, save those who shall be engaged in the work, and that the canal, when completed, will be of some advantage to the western section of our state, and greatly beneficial to the town of Alexandria, in Virginia, I shall be content to surrender one million, to the canal company, upon the express condition, under their corporate seal, that they make no further demands on the state.

Colonel Kearney states the tantalizing fact, that in the year 1836 fifty thousand travellers passed between the north and the south; but adds, rather ambiguously, "whether, arriving at the Roanoke river, the choice being before them, of the route to Richmond and Potomac creek, by Norfolk and the Chesapeake bay to Frenchtown, or by your road by the bay and peninsula, is a question which the friends of the rail road will willingly leave to the decision of the traveller." It seems quite certain that the friends of the Eastern Shore rail road, will submit to the traveller a question over which they have no control; but it may be well doubted, if the decision be against them, whether it will meet their cordial approbation. I do not know how the friends of the rail road read this paragraph; to me it appears the language of non-committal.

Col. Kearney proposes making the Tangier sound a winter harbor for the ships of Philadelphia, Wilmington and Baltimore, and transporting their cargoes by the rail road to their ports of destination. As far as relates to Philadelphia and Wilmington, the proposal is answered by telling him, that there is now an excellent winter harbor, formed by the breakwater, at the mouth of the Delaware; and a rail road from the Cape, to strike the rail road at Wilmington, is now under consideration; when this shall be accomplished, foreign goods can be transported to those cities, and cargoes carried by the return cars. By this means, Jack Tar may be kept constantly at sea, free from the temptations and corruptions of the city, and perhaps Philadelphia may regain her commercial ascendency in the country. I am inclined to think the Baltimore ships, after having made safe anchorage in Hampton roads, would prefer awaiting a thaw, to encountering the shoals of the Tangier sound, in the winter. The genius of internal improvement is now on the wing, and in full flight. I have somewhere seen a proposal to transport India goods to a port on the Columbia river, and from thence by rail roads over the Rocky Mountains, to the United States. There is a citizen of Baltimore who has in project an air ship to sail against all currents below the moon, who will engage to make a trip from Boston to Mexico in six days, and to deliver the mail at all the important commercial points. He only wants ten thousand dollars to put his bark in sailing trim; and Congress, by patronizing this undertaking, might find it the easiest

mode of putting down Amos Kendall's express mail; and no more horses would be run out of their lives in carrying the President's message at an extra session.

There seems to be no reasonable doubt that in a short period, there will be a line of communication from north to south by railways. The best and most practicable routes ought to be selected.* Rail roads are constructed at great expense, and wherever there shall be two or more leading to the same place, the one of preference will beggar the others. A rail road is now in progress from Portsmouth, by the Roanoke, to Charleston. A large section of a rail road from Richmond to Potomac creek, has been completed; and I think there can be but little doubt, that in a short time, it will be extended directly to Washington, where it will meet the rail roads now completed to New York. The most eligible connecting line from the south, seems to be from the Roanoke to Richmond; by this, the traveller to Philadelphia or New York would touch at Richmond, Washington and Baltimore; and if Col. Kearney be right, that land travel will always be preferred to water, it settles the question. But supposing the Eastern Shore rail road to be completed, that the travellers should all from the south arrive at Portsmouth, and the two routes presented, if they elected the one by the bay and peninsula, the first eighty-five miles would be by water; when they arrived at the Tangier sound, they would be greeted by a cloud of moschetoes which would bear them company to the Delaware line. They would there take on a fresh supply, from the Delaware marshes, whose attachment would remain unshaken till they attained the high lands of Kent. They would let their blood freely, and the unfortunate travellers would there part with them with as much satisfaction as the pious Eneas did with the harpies, in his journey to the promised land. In addition to other discomforts, the road passes through a dark gloomy Siberian forest, which no art can improve.

I do not agree with Col. Kearney, that land travel will always be preferred to water. I have not much confidence in the scheme of crossing the Atlantic ocean in steamboats; but twenty years has given full confidence to steam navigation on the bay. The terrible disasters from steam cars are fresh in our recollection.† I have travelled by both conveyances, and have always found more comfort and confidence in steamboats than in steam cars. A swift steamboat, will now make her trip from Portsmouth to Baltimore in sixteen hours, and if she start directly up the bay, to Frenchtown, would accomplish it in nineteen. The traveller. by this route, would perhaps lose three hours from Portsmouth to Philadelphia, but he would find full compensation in the superior comforts of the steamboat, which are little short of a well-regulated hotel.

I do not apprehend that the Eastern Shore rail road will ever progress beyond the survey and location; but if it should be constructed, the rust in a few years will eat out the rails, the brambles and black-jacks will resume possession of the site, and no memorial will remain, but the statute book and tax lists, which will furnish posterity with the evidence of a million of dollars improvidently granted, and uselessly expended.

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Eastern Shore of Md., Feb. 4th, 1838.

ON HILL-SIDE DITCHES.

To the Editor of the Farmers' Register.

Brownsville, February 1st, 1838.

The process of draining hill-sides of the water which falls upon them, so as to prevent washing, is one of deep interest to every cultivator. The wretched appearance of our exhausted lands, presenting an alternation of gullies and broom-sedge, and the damage done to the adjacent low lands

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* To adopt the route which will command the most transportation, and yield the most profitable dividends, is a consideration of still more importance than choosing the "best and most practicable route" for a railway.—Ed. Far. Reg.

† The disasters which have occurred on several rail-roads have been terrible indeed. But in every case, so far as we have been informed, the killing or maiming of passengers has been caused by gross neglect, or inexcusable arrangements for the conducting of the train, and might, by proper care, have been entirely avoided. Let then the blame be laid where it is due, and not charged, as it has improperly been, to accidents necessarily and unavoidably attendant on railway travelling. The meeting and awful collision of two trains might even had occurred, as on the Portsmouth and Roanoke railway—or the engine and five or six of the nearest cars might have been precipitated from a high bank, (although both these accidents might have been easily guarded against,) and yet no passengers would have been hurt, if they had been placed *in the rear* instead of *in front* of the heavy burden cars—which, instead of themselves receiving and sustaining the shock, served, by their momentum, to rush upon and crush the frail coaches, which were so improperly placed ahead, when the trains were suddenly stopped. This improper arrangement has since been corrected on the Portsmouth and Roanoke rail-road, as it ought to have been long before.

It is impossible that any kind of travelling can be secured from every possible accident. But if experience can be relied on to furnish evidence, it may be safely assumed that a well-managed railway is the safest mode of travelling, next to well-managed river (*not Atlantic or Chesapeake*,) steam vessels.

On the railway from Petersburg to the Roanoke, (sixty miles in length) there have been conveyed largely above 100,000 passengers, since 1834, when its use was commenced; and of the whole number, not one has been killed or maimed, or even seriously hurt, *who was in his proper place, in a coach for passengers.* The few cases of maiming and death, or serious hurts, which have occurred, were either of the conductors or other agents of the train, who were on the locomotive engine, or of others in exposed situations—and never of passengers, when in their proper places. If these facts do not prove that the rail-road furnishes a very safe mode of travelling, we are at a loss to know what kind and amount of evidence would suffice for that purpose.—Ed. Far. Reg.

by the *top-dressing* of gully clay, admonish us that some remedy for this evil must be adopted, or that this ulcer will increase until it has eaten up all the soil on our broken lands. My own observation has led me to the decided conviction, that lands moderately hilly are much the most desirable, both for productiveness and permanency, as arable lands. They are less liable to sourness by retaining an over portion of water, and can be worked with propriety when level lands are sobbed and wet; and upon an average they are usually most fertile by nature. An injudicious system of culture has exposed them to destruction from washing, and so general has been this operation, that but a small portion of the hilly land, which has been cleared for 20 or 30 years, is of any value whatever. I I was an attentive reader of the many interesting and instructive papers, published from time to time, in your journal on this subject. I have for the last fifteen years, attentively observed the various plans which have been adopted by my neighbors and others in relation to this important end, and am much gratified to observe a manifest improvement in the condition of things. A protracted discussion was maintained in your Register, as to the relative value of hill-side ditches, or another system which I was never able fully to discriminate from it; there seemed to be, in fact, but little difference between the mode proposed by Mr. J. C. Bruce, and your correspondent "Wardsfork;" they mainly differed as to the propriety of letting off the water on a plot of herd's grass, or discharging it in a ditch between the hills. My own experience has fully confirmed me in the conclusion, that the water should be discharged on a permanent grass plot, which should always be sown in every ravine when land is first cleared, and in old lands, on the first effort to improve them. When the field is in cultivation, they may be mowed for hay; when in pasture they are much the most productive parts of the whole. The imperfection of the hill-side furrow, or ditch, whether opened with the plough and hoe, or with the spade, is, that heavy rains cause them to overflow and break, and fill them up with sand and mud; and where they break, a gully is made at once. The cleaning out is a serious labor, and if neglected, they become utterly worthless. They are often constructed with too little fall, and almost uniformly too long. If dug out with a spade, and made deep and wide enough for the discharge of very heavy rains, they require bridges to pass them with carts and wagons, and are very inconvenient in obstructing free passage in hauling up the crops. I have tried each of the above described plans, and am disposed to change them for one which I shall proceed to describe. Before doing so, however, I must remark that I approve of all the plans to a great extent, as all of them preserve land, and are decidedly preferable to the old destructive system.

My attention was first called to what I esteem the best mode of draining and preserving hill-sides, by the practice of Richard N. Venable, Esq. of Prince Edward; who has combined the most efficient means of preserving land from washing, and reclaiming that already washed and gullied.

Instead of a graduated ditch or furrow with a bank thrown up by the plough or spade, which presents an uncultivated ridge, all along the bank of the ditch, grown up with briers, bushes and weeds, a bed should be thrown up by the plough ten or eleven feet wide, graduated with sufficient fall to discharge the water, with a deep water-furrow on the upper side of the bed leading to the first ravine, where there is a grass plot to receive the water and conduct it off. This bed is ploughed up with the rest of the field, and cultivated with it, always taking care that the bed is left in the same place, and the furrow opened with the plough. These beds are made sufficiently numerous to drain all the water which falls on the land; and the intermediate spaces cultivated level, or as may be preferred, or according to the nature of the crop. This bank or bed being wide and strong, and withal of a capacity to be measured by estimating the space from the highest part of the bed to a corresponding level above it, will rarely, if ever, overflow; and if it should, it will only discharge the surplus water, and not cut away the whole wide bed, as it always does the bank of the ditch or furrow when the accumulation of water causes a breach in the bank. Under this system, the whole field is cultivated, and you will have to walk over it in order to see the beds; the eye is not offended with those uncultivated banks which wind around the hill, and present obstacles both to ploughing, and passing with plantation carriages. Herds' grass seed should be sown in the bottoms of all the gullies, and protected with a little brush, and stimulated with a little manure; and a draining bed heaped up at its head, the sides of the gully gradually ploughed down, until it presents after some years merely a wave in the land, and is ultimately reclaimed.

I consider herds' grass the great reclaimer, as well as preventive of washing in lands. Unlike clover and timothy, or most of our indigenous grasses, it is a perennial turf; having this advantage of green sward, that the turf is stronger, resists the sun and drought better, and will grow on poorer soils, as well as in the most swampy and wet. It is a great producer, and makes the finest hay. I repeat the advice to sow a narrow belt of from twelve to fifteen feet in each considerable ravine, which must be permitted to stay untouched; when the field is ploughed for cultivation it is a complete protection against any wash there; a fine spot of meadow or pasture; and the additional moisture which it receives by being used as the receiver and conductor of the hill-side water from the draining beds, secures a certain and heavy crop, for grazing or hay.

In order to complete success, the beds should be as short as convenient, and the fall considerable, just so as to prevent washing in the discharging furrow. It is always best when there is a considerable distance between two ravines, to begin in the middle of the hill-side, and discharge the furrows each way; thus securing a rapid passage to the water, and effectually preventing such accumulation as would overflow the beds. Land thus laid off should be always cultivated with reference to this organization, and the bed will retain its height and position.

I have on my farm each of the modes of draining and preserving hill-sides in use, and decidedly prefer the last described, and shall adopt it exclusively as the shifts are brought in cultivation. I have thrown out the above hints and send them to you, that if they should be thought of sufficient value, they may be published in your Register.

A. W. VENABLE.

ON GRASS, AND GRAZING, ON ARABLE LANDS.

To the Editor of the Farmers' Register.

Brownsville, February, 1838.

Dear Sir:—A day of leisure enables me to redeem my promise of making a communication to your Register on the subject of grasses. A very superficial observer must be convinced, that the destruction of our land, dreadful as it is, has been greatly retarded by the natural grasses which our country produces. The crop-grass has, by its strong roots and vigorous growth and heavy production, arrested in no small degree the destruction which shallow ploughing and imperfect cultivation has been spreading over the land. Even broom-straw and sedge have done much to prevent things from getting worse; and but for the fact that all of our indigenous grasses, except green sward and one or two varieties of swamp grass, are mere annuals, the good done would be much more extensive, even with the most inferior. I think much has been improperly ascribed to grazing, in the account of bad management and destructive agencies. It is true, that land not sown with artificial grasses, (particularly as those indigenous do not make pasture until the middle of May or 1st of June,) and grazed with a heavy stock from the 1st of April, poached in wet weather, and kept naked and exposed to the sun, will become poor and unproductive. But this results not so much from grazing, as from treading. The grass was not there to be eaten off: the injury arose not from grazing. but an absurd and fruitless attempt to graze. The poor cow is as much exhausted by a fruitless search for food, as the land is by the treading. In our planting country, it would be amusing, were it not too serious a subject to be laughed at, to see a stock of cattle returning at night in the spring from *a budding expedition.* The stock of winter food, composed of straw, stalks and shucks, is exhausted. The buds are putting out a little, and the cattle are belled and turned out to shift for themselves. A few of the strongest reach home in the evening; the rest are to be found reposing at various distances from the pen, as fatigue and an almost fruitless search for food, have exhausted them. It is thus that some of our planters lose about cattle enough in the winter to furnish them in a supply of very inferior leather from their skins. Cows on the lift, and cows in the mire, in March and April, are nothing new in a planting country. The reason for this is, that planters have been engaged in clearing forest lands and have made no meadows. They rely on the offal of the grain crop to support the stock of cattle. They are a mere save-all, and accounted clear gains, and make but little of the reliance for profit.

This state of things was better sustained when the country was fresh, and the amount of offal from the grain crops very large. A decline in productiveness leaves less for the cattle to consume, and it is necessary to make provision for their wants. I am satisfied that there is no improvement without a full stock of cattle. That grazing properly and even heavily at the right time, and in the proper manner, is, so far from being injurious, beneficial to land, and promotive of its productiveness. Every farmer should keep just as many cattle as he can keep well, and graze them on his best lands. I know lands which have been cultivated on the clover and enclosing system, until they will bring but little else than weeds and briers. A crop of corn is certainly destroyed by the myriads of insects and worms bred in and inhabiting the soil; and when fallowed, weeds overpower the wheat. Treading on land, well covered and guarded with a turf or a heavy lay of clover, is advantageous to the succeeding crop. It gives the land the requisite degree of closeness, and destroys many of the insects and worms which would otherwise prevent the establishment of the crop. Besides, the improved stock, the increase of milk and butter, as well as beef, are to be estimated in the account of comfort and profit on the farm; and the lands are better than those left to the natural grasses, for pasture and for cover.

An evidence that constant, and even heavy grazing, does not of necessity impoverish land, is to be found by observing the common about every town, village, or other public place. All of the neighboring stock graze on it; and if it is kept a common for thirty years, it will be seen to become better and richer, and gradually exchange its grasses from the most inferior to green sward, which is the best. Cattle should be fed until the first of May, and then turned on a herds' grass pasture. They may be turned on the clover about the twentieth of May, and permitted after this to glean the harvest fields; after which they may be turned on the newly-mown meadows, and other pasture, natural and artificial. Rye sown in August on the corn land, or early sown wheat for pasture, will keep colts, calves, ewes and lambs, early in the spring. But the thing for which I contend and wish to establish as a maxim is, that the best use to be made of grass, is to have it eaten. You can never persuade men to sow grass merely as an improver. They must have the immediate profit, or they will not sow it; and I say, use the grass, improve the stock, and whilst you fatten your land, let your land fatten you. Every man who will sow clover, timothy, or herds' grass, even though his land were not rapidly improved, will be fully compensated by the increase of domestic comforts, as well as beef and butter as articles for market, and the excellent economy of raising his own horses for the use of his estate. Could this impression become general, it would do much to obviate the objections urged against the purchase of grass seeds, and the general introduction of artificial grasses, and the consequent restoration of our country. It would cause our people to be contented here to live well on their farms, and not emigrate to the west, where by a most distressing self-denial, and surrender of all comfort, the acquisition of wealth is attributed to a superiority in the country; the fact being, however, well established, that such rigorous and unbending parsimony and industry would make men rich here or there.

A. W. VENABLE.

EXPERIMENTS ON THE CORN CROP.

To the Editor of the Farmers' Register.

Coggin's Point, February, 1838.

Permit me to report to you a statement of a few experiments, made last season on corn; which, if not important, may at least prove interesting to some of your numerous readers.

Experiment 1st. When planting corn, a piece of rich ground was selected, containing 1428 square yards, on which corn was planted 2 feet 9 inches

between the rows, and 9 inches between the hills, and in rows 1 foot apart and 1 foot between the hills, with a space of 3½ feet between every third row, (after the mode described by Mr. Camak in the 763rd page, 4th vol., F. R.) This corn received no after-culture; but when about one foot high, 32 loads of pine leaves were scattered on the ground, which they then covered to the depth of nearly 4 inches, but afterwards settled down to less than 2 inches; and, as I afterwards found, this covering was not sufficient to resist the effects of the severe droughts which occurred during the season. On the 2nd December, the corn from this experiment was shucked and carefully measured; the result was 20¼ bushels of sound corn, being at the rate of nearly 75 bushels to the acre. Large as is this return, I have no doubt that had the covering of leaves been sufficiently thick to have withstood the effects of the droughts, the results would have been much greater. The corn planted was the Maryland twin corn. It may probably be worth mentioning, that the number of black spongy ears so frequently found amongst corn, was unusually numerous even amongst this thickly-planted patch.

Of about 30 acres planted of this kind of corn, I would also remark that the result was below the average of the general crop of common corn; the principal stems generally produced two, sometimes three small ears; few of the suckers produced any. I also find that in this case at least, this corn does not turn out so well in meal; the bread made from it appears to me to be less sweet, also drier and harsher to the taste, than that made from our common corn. On at least one farm in this neighborhood, similar results have been observed. I mention this (without supposing that such are the general results,) for the purpose of ascertaining whether such results have been observed by others who cultivate this variety of corn.

Experiment 2nd. On the 11th September, 24 rows of corn, 150 yards in length, as nearly alike as possible, were selected for a fodder-pulling experiment. On the same day the fodder was stripped from 18 of these rows, to two blades above the ear; on the 20th, the tops were cut from the first 6 rows; the second 6 rows were cut over by the ground; the third 6 rows were, together with the first 6 rows from which the tops had been cut, left standing until the cutting down of the general crop; the fourth and last 6 rows, from which neither fodder was pulled nor tops cut, was on the same day (20th September) cut off by the ground, and set up in small shocks. The corn from each was gathered, shucked and carefully measured on the 2nd December; and on the 7th of this month shelled and accurately weighed. The following are the results, in measure and weight:

1st 6	rows measured	8 bus.,	weight per bus.	58 lbs.
2nd 6	do.	7¾	do.	57
3rd 6	do.	7⅝	do.	56¾
4th 6	do.	8½	do.	59¾

This experiment has been made as carefully as possible, and the results ascertained accurately, as above stated. So far, it certainly affords [no?] evidence of the injury sustained by the usual practice of pulling fodder and cutting tops. I leave your readers to draw their own deductions; merely remarking, that the results appear to me somewhat curious. The diminution in weight per bushel appears to bear a relative proportion to the diminution in quantity. The result from that part of the experiment from which the tops were not cut (No. 3rd) and left standing, until the cutting down of the general crop, is the least; being less than that from No. 2, which was cut over by the ground, (having the fodder also stripped,) and shocked when the tops were cut from No. 1.

In conclusion, I would also state that a portion of the corn crop of last season was left unsuckered, for the purpose of ascertaining the probable advantages or disadvantages of the usual mode of suckering. Without having had recourse to actual measurement, the result, in this case, at least, was sufficiently obvious in favor of that which had been suckered; very few suckers produced ears; the ears on the main stems were small, and the number of barren stalks unusually great. In making this experiment, my attention was directed to an article in the 5th No. of the current volume of the Register, from the 'Germantown Telegraph,' in which the theory is held forth, that nature intended the suckers to "furnish a better supply of fecundating pollen to the silks, or female flowers." This experiment furnished no evidence in favor of this theory. Corn is a monæceous plant, and as such, nature doubtless intended that each stalk should of itself be independent; the fact that female flowers, whose stalks have been deprived of the male flower, will be fecundated from a neighboring plant, notwithstanding.

ANDREW NICOL.

DEEP PLOUGHING INJURIOUS ON CERTAIN KINDS OF SOILS.

To the Editor of the Farmers' Register.

The general tendency of the views of the agriculturists of the present day, seems to be decidedly in favor of very deep ploughing. The adverse of this position, seems to have but few supporters. The apostle Paul says, "try all things, and hold fast to that which is best;" we try all things, but hold fast to that which is of most recent date. The poet says, that "nought beneath the sun is new; but still from change to change we run!"

There are lands very much improved by deep ploughing; such as the red lands of Goochland, Albemarle, and some of the adjacent counties. The basis of the loam consisting of red alumine and silex, in the form of sand or coarse gravel. The admixture of this alumine, in a large proportion with the siliceous matter of the surface, renders the soil thus formed, greatly more productive in wheat, clover, and, when the seasons are wet enough, in corn also.

I reside in a section of the state, for the most part, very different from the red lands to which I have referred, and in an extensive tobacco-growing county. A large proportion of the lands in the northern section of this county, assume the character, on the surface, of a very sandy grey soil; the substratum of sand, and the stratum beneath this, a soft porous rock. Upon such land as this, it would be worse than useless, it would be mischievous, to turn the surface deep and bring up in lieu thereof a sand perfectly steril. I have tried the experiment of deep ploughing in such land, and have lived long enough to see the deleterious

effects of it; "no argument like matter of fact is."

Another description of soil not very uncommon with us, is a coarse, dark, grey, gravelly loam, with a good deal of rock on the surface, and intermixed with the soil— he substratum of a very tenacious, close, yellow clay, which it is nearly impossible to raise with a folding plough, and when raised, best allowed to remain where it was. I have found the admixture of this clay with the loam, renders it very close, heavy and tenacious when wet, and hard when dry.

We have still another description of soil, which I believe, in my soul, is the worst of the whole. I allude to a coarse gravelly loam, with a substratum of ash-colored clay: this requires the surface to be turned more superficially than any other land, as nothing can be gained by mixing the clay with the surface, the effect being a stiff, cold, pipe-clay soil.

I am a decided advocate for the land we cultivate being broken deep with tools which leave the soil and substrata remaining in their relative positions. We should always leave the fertilizing principle as near the surface as possible, and where it is rendered most available in the growth of vegetation.

I have a large, and originally very impoverished estate, on which I have all the descriptions of soil above noticed. I used, for a few years after obtaining possession of it, deep ploughing, and the result of my observation is as above stated. I know nothing of the effects of deep ploughing on limestone or marly lands; such soils, I presume, might undergo great changes by the action of chemical agencies upon them when exposed to their effects.

I have for some time supposed, that the fertile red soils contain an active alkaline principle. I have been induced to this belief, on account of the rapid decomposition of vegetable matter in contact with such soil. I have heard several very intelligent farmers attribute it to the effects of lime; but am disposed to think, myself, it is potash, the most common alkali in the composition of vegetable substances. In ploughing up and exposing the clay of such lands, the potash contained in it undergoes a change by the action of the atmosphere, into a nitrate (or nitre) which is a great stimulant of vegetation. The nitre *(nitras potassæ)* is exhibited in a great many vegetables, and is frequently seen on the tobacco plant, having exuded from the stalk and stem in the process of curing and drying. I believe it is generally conceded, that fertilization takes place exclusively on the surface, and the roots of vegetables imbibing the nutritive principle, are those which run laterally and superficially; the tap root affording moisture only.

The action of the gases on the surface is very much dependent on the substances they come in contact with; thus round about Mount Etna, and on the lava poured forth by occasional eruptions of that volcano, after becoming indurated by exposure to the atmosphere, a very rich loam is soon formed of the greatest fertility, which I attribute to the action of the atmosphere on the potash of the ashes that are occasionally showered on the lava.

I. B. Rice.

Halifax, February 15, 1838.

From the Cultivator.

GREAT CROP OF CORN.

Laurens, December 1, 1837.

Judge Buel—Dear Sir—I send you a statement of the expense and product of an acre of Indian corn, raised by me, together with the mode of its cultivation. The corn was the little eight rowed yellow variety.

Soil and culture.—The soil is a warm sandy loam. It was ploughed deep in the autumn of 1836. About the first of May, I carried on, and spread all over the ground, about thirty loads of stable and barn yard unfermented manure, then rolled and harrowed the ground well, being careful not to disturb the sod, which was timothy, and mown the summer preceding; and on the 9th and 10th May planted the same, two and a half feet between the rows, and fifteen inches between the hills. It was dressed with ashes when it made its appearance above ground. On the 10th June commenced weeding and thinning, leaving from two to four of the best spears in each hill, the whole averaging about three spears in a hill. After this I ashed it again, using in all about ten bushels of good unleached house ashes. On the 10th of July commenced hoeing, and at the same time took off all the suckers—put no more earth about the hills than we took from them, but carefully cleaned out all the weeds from the hills. The seed was prepared by simply wetting it with warm water, and rolling it in plaster.

Harvesting.—The corn was cut up the 18th September, at the ground, and shocked in small shocks; and on the 9th of October it was housed and husked, and subsequently thrashed and measured.

Product.—Ninety-nine bushels of first-rate corn, without even a nubbin of soft or poor grain, owing to the fact, probably, that there was no suckers on which to grow them.

Expenses.

Ploughing one day and board,		$2 00
Rolling and harrowing one day,		2 00
Seed and plaster,		1 25
Planting two days, at 75 cents,		1 50
Five days hoeing and board,		3 75
Horse and hand with cultivator two days,		2 00
Cutting up and shocking two days, 75 cents,		1 50
Husking and housing ten days, 75 cents,		7 50
Ten bushels ashes, at 25 cents,		2 50
Labor on ruta baga, (sown among the corn,)		1 50
Interest on land, at $50 per acre,		3 50
Thrashing corn, three days,		2 25
35 loads manure, at 25 cents,	$8 75	
Carting and spreading do.	8 75	
	17 50	
Deducting two-thirds for succeeding crops in rotation,	11 67	
		5 83
Total charges,		$37 80

Value of Produce.

70 bushels seed corn,(selling price,) at $2,	$140 00
29 do. sound do. (do.) at $1.25,	36 25
4 loads stalks, at $2.50,	10 06

20 bushels ruta baga, at 25 cents,	5 00
1 load pumpkins,	1 00
	$192 25
Deduct expenses,	37 08
Nett profits,	$155 17

H. HOPKINS.

I hereby certify, that I am personally acquainted with the above named Henry Hopkins, believe him to be a person of veracity, and that the truth of his statement may be depended on.

A. MARK, *Jus. Peace.*

From the Cultivator.

GREAT RUTA BAGA CROPS.

Lenox, Madison co., Dec. 6th, 1837.

Mr. Buel,—Sir,—I saw in your March number of the Cultivator, a premium offered on several articles of agriculture; I therefore send you a statement of one acre of ruta bagas raised by me this season, hoping, if it does not prove a successful competitor, the cause of agriculture may receive an additional witness in its behalf. The soil is a rich mould of sand and clay, containing besides the vegetable decompositions, some lime, and a small portion of the oxide of iron. It is first-rate wheat land. The manure was drawn in the fall and ploughed in, which I deem very essential in raising this crop. About the 15th of June the seed was sown in drills about twenty inches apart one way, and from eight to ten the other. I raised from one and three-fourths acres 1,800 bushels; the three-fourths of an acre was not as well prepared as the other. The product of the acre was as follows:

Dr.	To 30 loads manure, at 25 cents,	$7 50
	" carting and spreading the same,	7 50
	" ploughing one and a half days,	3 00
	" rolling and harrowing,	1 00
	" seed,	50
	" sowing one-half day,	50
	" three hoeings four days each, at per day,	10 50
	" harvesting eleven days, at 6s.	8 25
	" interest on one acre, 75 dollars,	5 25
		$44,00
Cr.	By 1,120 bushels ruta baga, 1s.	$140 00
	" tops for fodder,	6 00
		$146 00
		44 00
	Balance,	$102 00

WILLARD COTTON.

State of New York, Madison county, ss:

I, Stephen Chapman, a Justice of the Peace of the town of Lenox, in said county, do certify that I am well acquainted with Mr. Willard Cotton, whose name appears to the above; and that he is a man of truth and veracity and entitled to full credit.

S. CHAPMAN, *Justice of the Peace.*
December 15, 1837.

From the Cultivator.

J. Buel, Esq.—Sir,—I have cultivated during the past season one and one-third acres of ruta baga turnips, on half of an acre, of which I measured and had five hundred and seventeen bushels of roots. It was a clover sward, which had been pastured one year; soil a sandy loam. Before ploughing I put on fifty loads of barn-yard manure; I ploughed it one week previous to planting. I put in my seed in drills two feet and a half apart; time of sowing was on the 22d June.

50 loads of manure, at 6s. per load,	$37 50
Spreading and carting, at 1s. do.	6 25
Ploughing one and one-fourth days, at 16s. per day,	2 50
Harrowing one-half day, at 16s. per day,	1 00
Sowing seed one-half day, at 8s. do.	50
Weeding three times 30 days work, at 4s. per day,	15 00
Going through with cultivator three times, at 12s. per day,	2 25
Pulling roots, ten days work, at 5s. per day,	6 25
	$73 25

On the one and one-third acres I had 1,303 bushels roots.

1,303 bushels of roots, at 3s. per bushel,	$488 63
Deduct expenses,	73 25
	$415 38

JOHN J. BULLOCK.
Bethlehem, Nov. 18*th*, 1837.

From the Journal of the Franklin Institute.

SPECULATIONS RESPECTING ELECTRO-MAGNETIC PROPELLING MACHINERY.

By the Editor.

In our number for November last, vol. xx, p. 340, [see Farmers' Register, p. 603, vol. 5,] we published the specification of Mr. Davenport's patent for a machine intended to furnish a motive power by the agency of electro-magnetism; to which we appended some remarks upon the subject generally. We had hoped, ere now, to have received more definitive information than has transpired, respecting the progress of the experiments which are being made in New York with a view to its testing the utility, by applying it to drive a Napier Press, requiring a two-horse power; we have hitherto learnt nothing of the result of this proposed experiment; and suppose, therefore, that the trial has not yet been made.

Since publishing the article above alluded to, it has appeared to us that should a much less power be attained by such a machine than that which is now sought for, say the power of a man only, it would still be equally valuable with the steam engine, and would produce as great, if not a greater change, in the economy of the useful arts, as has been produced by that instrument; this, however, is under the proviso that the cost of materials consumed in performing the work of a day should be less than that given for the labor of a man. Who is there who would not, under such circumstances, need such a machine? If we hire a man by the day, we must not allow him to be idle, as in that case we give our money for nothing. The current of his life flows on, and he must be fed and clothed, or the stream will stop. But give us a

machine which is not costly at first, and which if it works but one hour in the twenty-four, will itself be a consumer in that proportion only; a machine which we can at any moment set to turn our lathes, our grindstones, our washing machines, our churns, our circular saws, and a catalogue of other things which it would be no easy task to make out; such a machine would also perform a million of other operations, by the conversion of the rotary into a reciprocating motion; and we again ask who *is* there among us who would not want one? our farmers, our mechanics, and our housekeepers generally, must all be supplied. We could no more submit to live without it, after it has been once introduced, than we can now submit to travel at the slow rate of ten miles an hour, an event which we have learnt to think one of the miseries of human life.

With such a machine at our command, we should soon wonder how we could have lived so long without it; and if taken from us, it would leave a most awful chasm in the necessaries of life, of the existence of which our fathers never dreamed, and which happily we could not be called upon to witness so long as the store house of nature would enable us to obtain zinc and sulphuric acid at a cheap rate.

The steam engine cannot be used to advantage where it has not the labor of several horses to perform; as, whether large or small, it requires the constant attention of the engineer, or of the fireman, and is kept at work at an expense which is relatively increased as its power is diminished. One giving the power of a man only, would be employed at a cost which would pay the hire of two or three men, and if used but for an hour or two in the day, the expense would be incalculably increased; of course it is not, and never will be used, under such circumstances.

Let it not be said that we are prophesying about what is to happen; not so by any means; but be it remembered that we are speaking of what is a possible contingency. We have no doubt respecting the practicability of obtaining the power of a man by the agency of electro magnetism; we believe that such a machine may be kept at work without any considerable tax upon the time of the person using it, and we further believe that the only thing which can prevent its coming into use is, the cost of the materials employed in operating it. The statements which we have heard upon this point are extremely contradictory, and upon the whole, are far from encouraging; the time, however, is not remote when this point will be determined.

PLANTING CORN BY A MACHINE. TOBACCO CULTURE. LEAVES AS MANURE.

To the Editor of the Farmers' Register.

Goochland, Feb. 9, 1838.

As the season for planting corn is approaching, allow me, through your valuable paper, to recommend to the public the use of my corn planter in planting their corn. In 1818 I made an improvement ou the corn-planter, and it answers the purpose so well, that I have not planted a crop without one since. It certainly plants corn better than I have been able to plant in any other way. My neighbor, Capt. J. M. Vaughan, whom I consider one among the best farmers of my acquaintance, told me last spring that he would not plant a crop without one, if he were compelled to buy one every year. And one properly made and taken care of, would, I think, last thirty years. It is so constructed that it can be made to drop the corn at any distance apart you may wish, with the same planter, from one foot to six. Or, it will scatter it all along the row, if it should be preferred. And it is so simple, that any rough workman can make them if he has one to look at. And by making a division in the hopper, it can be made to drop plaster with the corn. If any person should wish to get one, I expect they could be supplied in Richmond; as Capt. Blair Bolling, of that place, has made several for persons in that neighborhood. Any workman there could look at one, and make them. A good ploughman, with a brisk horse, can plant eighteen acres per day. When I have been recommending them to my friends, they would reply that their land was too rough to be planted with a corn-planter. But, said I, "If you had one, it would put it completely in your power to make your land as fine as you would wish it. As all the operation of planting would be done with one hand and a horse, you could employ the balance of your team and hands in preparing the land before the planter." In preparing my land for corn, I use the five-hoe cultivator, drawn by two horses, and follow that by the log-drag. But if the land is turfy, I use the two-horse rake instead of the log, which tears the turf all to pieces, and puts the land in fine order. After all, if the land is rough, I put one horse to a two-horse plough and run before the planter; by just skimming the surface, which puts all the clods and turf out of the way of the planter, and it will plant the corn as well as it can be done.

As I am a tobacco maker, and perhaps my mode of preparing my land aud cultivating that crop may differ from some, and we all think our way best, I will inform you, as well as I can, my way of cultivating it. Every tobacco maker knows that his land should be well prepared before he commences making his hills; but instead of making hills, I prefer to list all old land. It does not only save the labor of making hills; but I find, from many years experience, that the tobacco will live better when planted in lists, than it will in hills, and will stand a drought better. To regulate the distance I wish to plant my tobacco on the list, I let in a tongue about four feet long, with an inch and a half auger into a piece of oak scantling three inches square, into which piece I let in three blocks with the same auger three feet apart, and six inches long; those blocks should be three-square, and about four inches wide behind; and fix handles to it as you would to a harrow. With poles nine feet long, I lay off my rows across the list with this implement, which lays off three rows at a time, thereby despatching the work three times as fast as you could with a plough or coulter, and your rows are more regular, because there is no splitting. I make all my tobacco on manured land, except some few spots that are rich enough without it. I have some fine tobacco land that I might clear; but as I have a plenty of open land, and I think I can manure two acres with less labor than it would take to clear one, I prefer to manure. My principal resource for manure is leaves from the woods. The first thing I do after sowing wheat

in the fall, is to rake up leaves with all hands, when there comes a good rain, to make them properly wet. I think it important they should be wet when they are heaped up. In that case, they will rot faster in the woods than they will in the farm pen, and I use a great many without carrying them to the pen. I haul up all my corn stalks, and use them as provender to my horses and cattle, and find they answer as provender for horses much better than they do for cattle. By putting them in the rack, the horses will pick them perfectly clean; whereas the cattle will trample them down without picking them half. When I am ready to haul out my manure, I lay off my land thirty-six feet each way, and drop an ox-cart load on each check, which gave me thirty-three loads per acre. I then open furrows, with a two-horse plough, the width of my tobacco rows—say three and a half feet, or three feet eight inches. I put the manure in them, and list upon it with four furrows to each list. When my farm-pen and stable manure gives out, I go on with the leaves which were raked up in the fall and left in the woods, which are, by this time half rotted. On the part of the land that I put the leaves which have not been to the farm pen, I put on at the rate of twelve cart loads per acre of stable manure on the top of the clap of the hoe, after I cut off to plant, which takes about a double handful on each hill. When we commence planting, the planter will shove the manure a little to one side, and stick the plant under the north side of it, which acts as a protection from the sun, and it will make the tobacco eight or ten days fowarder than it would be without this top-dressing. The land that is manured with leaves in this way, will make as large tobacco as the farm-pen or stable manure will without it. I find a little top-dressing to be a most excellent application upon any land, rich or poor. It protects the plant from the sun, and it will live and grow off much quicker and bolder than it will without it. By putting the manure in the drill it will bring as large tobacco as double the quantity spread broad-cast; and very common land manured in this way, will bring fine tobacco. I think the use of plaster on tobacco of great importance. I apply it by sprinkling on the hills at the rate of a gallon to four thousand hills; and if you apply ten times that quantity, it will have no more effect.

In cutting off my land to plant, I cut just the width of the hoe across the list; and it is important that you should cut entirely across, so as to let the clap of the hoe be as high as it is on either side, to prevent the plant from being smothered by a hard rain. When I commence turning down, I work up the row between the list by going twice in each row with a three-hoed harrow. And then with a single-horse rake, two feet wide, I go across the list, which takes away the ridge that is left between the plants, and leaves very little work for the hoe. In preparing your tobacco land for wheat, you should plough and rake across the list, which will scatter the manure, and make a fine preparation for wheat. If you will use your manure in this way on a different part of the land every year, you will find the tobacco crop not so great a bar to improvement as it is said to be; and I think it indispensable that we should make it. For as long as the Hessian fly remains with us, we cannot rely on the wheat crop.

THOS. B. GAY.

From the Maine Farmer.

STIMULATING MANURES.

Most of our farmers are somewhat averse to trying new experiments in the art of cultivation, and yet of all new arts which are practised by man, there is none in which there is more need of them. Those experiments which require great expense at the outset should be instituted by societies or by those who have both money and time to devote to them. Many very important experiments may be tried by the man of very moderate funds, for they may cost but little else than the time consumed in performing them. One subject which we would name, is stimulating manures, though perhaps the word nutritive would be better than stimulating. After the plant or crop is up, what is the best application to cause it to thrive? Liquids in which manure has been soaked are often used for particular purposes. We recollect that an old friend of ours once amused himself by pampering a squash vine, which he pushed forward to an immense length, by watering it every day with a liquid which he drained from his pig-stye. He applied it not only to the main roots, but also to the little radicles which put out at intervals along the vine. No doubt there are many articles, at cheap cost, which may be used to great advantage.

We quote the following use of the *chloride of lime* from a French work. Mr. Dubuc, a French apothecary, has discovered that muriate of lime (chloride of lime dissolved) is a very active manure, or vegetable stimulant. He dissolves about two and a quarter pounds of the dry chloride, in about sixteen gallons of water, and with this solution waters the plants at distant intervals. He sprinkled a light soil with this fluid, and eight or ten days after, planted it with maize, and from time to time during the season, watered the corn with the same solution. Another portion of corn at six feet distant, he watered with common water. The former yielded double the produce of the latter. A large variety of plants and garden vegetables were tried in the same manner and with similar results.

The sunflower, (helianthus) which at that place rises only six or eight feet, grew by this treatment to the height of twelve or fourteen feet, with flowers whose disks were eighteen or twenty inches in diameter, producing seeds which yielded half their weight in oil, good to eat, and exuding from its centre a transparent vein like turpentine, very odorous, and drying easily in the air. Potatoes were also tried. They were planted on the 1st of May, 1822, in two squares, six feet asunder; the one was watered with the solution, and the other with water from the cistern. They were gathered on the 10th of November.

The bed which had been watered with the solution, and only three times during the season, produced potatoes six inches long, twelve in circumference, and weighed nearly two pounds each. The others were in general only half as large, and their stalks in the same proportion. Three or four waterings with the fluid at distant periods are considered sufficient. Some ascribe its action to electrical agency.

Allowing one half the above statement for the natural enthusiasm of the French, when any thing new occurs among them, the solution must be a valuable stimulus for some plants. The chloride of lime can be had at the paper mills, or at

the apothecary's, for a few cents per pound, and the experiment may be tried, and if good effects described above, are corroborated, it certainly will be a valuable auxiliary. If it proves to be of no worth, still the experiment will be valuable as refuting the above statement, and proving that the results obtained by Mr. Dubuc must be attributed to something else.

From the Farmers' Cabinet.

IMPROVING A WORN OUT SOIL.

* * * * * *

Since my last essay was sent to the Cabinet, I have been engaged in the *agreeable hardship* of harvesting a heavy crop of grain and hay, which, with other engagements, has deprived me of leisure sufficient to examine an additional lot of horns which I designed to do, previous to sending any further statement of facts to the Cabinet. As an apology, therefore, of this neglect, I will transcribe from my Farm Ledger, a three year's history of an old worn out field, being part of a farm purchased in 1834.

This field, in the spring of 1835. presented one of the most dreary prospects to the eye of the farmer that can well be imagined. Corn had been the last crop, which was estimated at seven bushels to the acre, and the whole amount of verdure then upon the field appeared insufficient for half a dozen sheep the summer season, and not as much manure in the barn yard as would dress a common sized garden. Every thing necessary to improve this field had to be purchased; it was. therefore, no difficult matter to know the expense. The manure is all carried out at the cost delivered upon the field, and the field is credited with all the produce, except the pasture, at the cash prices in Wilmington, about 1¼ miles distant.

1835. FIELD, No, 3.	*Dr.*	1835. *Per Contra.*	*Cr.*
1st mo. 1.			
500 bushels of lime at 20 cents,	$100 00	300 bu. of corn at 80 cents,	$240 00
150 cart loads of manure at $1 25 per load,	187 50	175 bu. of potatoes at 30 cents,	52 50
200 bu. of bone dust at 30 cts. per bu.	60 00	1836.	
100 bu. of ground oyster shells,	15 00	96½ bu. of wheat at $2 00,	193 00
75 cart loads of manure at $1 25,	93 75	10 loads of corn-fodder.	15 00
Clover and timothy seed,	12 00	9 loads of wheat straw,	18 00
15 bu. seed wheat,	22 50	3 months pasture for 8 cattle,	24 25
Cost of 10 acres of land,	480 00	1837.	
		31¼ tons of hay at $14 00,	437 50
	$970 75		$980 25

The interest account against the field is not carried out, but the second crop now growing will considerably more than balance it, leaving the field to stand against the labor of cultivating three crops and taking them to market. It will be seen that the profits of this operation have all grown out of the manure. I have been thus particular, in order to obtain a knowledge of the value of worn out lands in the vacinity of manure. Stone lime can be had from the Schuylkill, and leeched ashes, bone dust, glue makers' offal, combmakers' shavings, and other kinds of strong manure will bear shipping from Philadelphia and Baltimore, up the creeks and inlets of the Delaware and Chesapeake bay. More again on this subject.

SUBSCRIBER.

Communicated for the Farmers' Register.

REPORT ON THE IMPROVEMENT OF THE ROANOKE RIVER, FOR SLACK WATER STEAM NAVIGATION.

To the Board of Public Works of Virginia.

Gentlemen: The duty which your honorable body was pleased to assign me, I commenced in the beginning of last August, in accordance with the instructions contained in the following clause of an act of the legislature passed 23d March: "That the Board of Public Works be, and they are hereby instructed to cause a survey to be made by some competent engineer, during the ensuing summer, of the Dan river from its confluence with the Staunton river to the town of Danville, and of the Staunton river from the same point to the town of Brookneal in Campbell county, and of the great Roanoke from Rocklanding to the confluence of the Dan and Staunton rivers aforesaid; for the purpose of ascertaining whether the said rivers may be rendered susceptible of steamboat navigation; and that the said engineer do report to the Board of Public Works, whether it be practicable to render the said rivers so navigable, and the probable cost thereof.

The Roanoke river from Rocklanding in North Carolina, to the confluence of the Dan and Staunton rivers in Virginia, has a fall of 156 $\frac{65}{100}$ feet, and the distance by the line of survey is 59 miles 5066 feet.

This river is, in general, of considerable width; in some places extending three quarters of a mile; from an average of eleven places of triangulation at the most favorable places for narrowness, and foundations suitable for the contemplated work, the width was found to be 360 yards; the general width need not however be considered under four hundred yards. The bottom consists mostly of solid rock; the wide and shoally portions are very shallow during a drought, of which I had ample demonstration; and from information obtained during the survey, from some of the oldest settlers, I learned that the water of the river had in no instance been so low, during the last thirty years. In other parts, the river is highly favorable, and requires but little artificial aid to effect its improvement; and in overcoming the more serious difficulties it may be necessary to cover the bed of some portions of the river, with more than the requisite depth of water, in order perhaps to cover a small shoal, or reach a point desirable for the erection of the contemplated works. Notwithstanding the considerable width of the river, the remarkably favorable natural foundations for the erection of dams, will render the latter not only easy of construction, but also of sufficient stability. The abutments will be of proportionably less expense, the greater the width of the river may be. Such descriptions of work requiring to be constructed higher in proportion, as the river becomes narrower.

I consider a sluice, or any part of a sluice navigation, to be entirely unsuitable for steamboats,

and, if such a system were adopted, the attempt would infallibly result in the creation of a continual source of disaster, besides the useless expenditure of large sums of money, without the certainty of the improvement ever being carried into effect—the works being liable to suspension from every ordinary freshet. On the other hand, the operations of the dam and lock system, can only be temporarily obstructed by high freshets; but the time consumed by such probable delays, is not likely to exceed ten days in the course of a whole year, or at most not exceeding the time lost on canals by the longer continuance of ice.

The extent and fertility of the country on both sides of the river would warrant a more costly and extensive improvement than that proposed; but it is questionable if a more beneficial one could be effected—the advantages to both sides being coequal; and successfully to establish a steamboat navigation by means of sluices, available at all seasons, would be an extremely difficult matter, in consequence of the river not being capable of furnishing a sufficient quantity of water during its low stages. The expense, during a few years, of the additional quantity of steam would equal the difference between the two modes, and it would, in my opinion, be more judicious to apply the cost of that additional steam power, to the construction of permanent works.

I concur in the opinion of the present superintendent of the Roanoke Navigation Company that "repeated and dear bought experience has fully proven that works of this kind (sluicing) can be successfully prosecuted only during the seasons of low water in the river; and to attempt it at other times is a wasteful and almost useless expenditure of labor and money." The capacity for the improvement that calls forth this remark was only for batteaux, carrying ten hogsheads of tobacco, and not a steamboat navigation.

Having satisfied myself that a sluice navigation would not answer the purposes contemplated in the above mentioned act, it becomes useless to give a description of the different falls existing in the river; it is only necessary to advert to those relative positions where the works require to be located. In advising a mode of improvement for steamboats on a river, the bed of which is composed of solid and detached rocks, it is indispensably necessary to provide an ample depth, with a sufficient width for a safe navigation. It is also equally necessary to reduce the current to its slowest possible state, for the purpose of diminishing the expense of motive power, and for the propulsion of all ascending vessels; and, to obtain, and successfully maintain, these important advantages, requires an improvement to be effected by a series of locks and dams, and, at the principal falls, short lateral canals.

The dams contemplated, rarely exceed in height more than the extent necessary to cover with a sufficient depth of water, the obstructions over which steamboats will pass; therefore, the injurious effects produced on marginal lands will be but small. As the abutments of a dam constitute a very important part of it, the plan contemplated, in order to give sufficient stability, is to construct the ends, in connexion with the dam, of smooth cut stone, forming a segment of a circle, and dove-tailed into one another as well as joggled, and the remaining portions of rock-work, that below the water, laid in hydraulic cement, and that above water, in lime mortar. With the exception of the locks, the estimate provides for every other part being done in the most substantial manner; and the plan recommended is to construct the locks of timber, which will cost 400,000 dollars less than if constructed of stone; and which will not only ensure an early completion of the works, but also supply a navigation, which will answer the double purpose of carrying on the inland traffic, and at the same time conveying the stone and other materials requisite for the construction of more permanent locks, and that at a reduction of cost equal to the expense of the wooden ones. Those stone locks can be erected without the least interruption to the navigation.

The greater number of the rivers in England (excepting the tide rivers), have been rendered navigable so far as practicable by locks and dams; and the system has been universally attended with complete success, not only from its supplying a complete and permanent navigation, but also from the increase of revenue derived from disposing of the valuable water-power acquired by the erection of dams. It is a method of improvement too, by which much money is saved from the nature of the constructures, the necessity for incurring the expense of digging, embanking, aqueducts, culverts, bridges, waste-weirs, &c., requisite for canals, being altogether dispensed with.

The cost of transportation of produce &c., on rivers by steamboats with lighters is ascertained to be about one cent per ton, per mile; and this may be safely considered as the expense applicable to, and not exceeding the cost of freight on the contemplated improvement; and, after its completion, it would not be exaggerating to estimate the amount of the ascending and descending trade to be 25,000 tons, transported one hundred miles out of the whole one hundred and seventy one and a half miles, the entire extent of the improvement, and the tolls at three cents a ton per mile.

25,000 tons at three cents per mile -	$75,000
From passengers - - -	6,000
Income from water-power -	7,000
	$88,000
Annual expense of repairs, superintendence &c.	25,000
	$63,000

Nearly equal to 10 per cent profit.

Dan River.

The plan of improvement for the Dan river, is similar to that recommended for the Roanoke; the former however is much more favorable, the fall being less, with a great diminution of the width, which does not exceed 170 yards. The fall between the confluence of the Dan and Staunton rivers and the bridge of Danville is 119 $\frac{18}{100}$ feet, the distance 62 miles 2937 feet.

It is a remarkable fact that the whole expense of the line of improvement now under consideration in connexion with the Portsmouth rail road on the east, and an extension from the extreme point susceptible of steamboat navigation on the Dan river, westerly by a rail road to the Holston river on the line of Tennessee, comprehending a

distance of 400 miles between the harbor of Norfolk and the above designated point, would not exceed the estimated cost of the Lynchburg and Tennessee rail road. A profitable line of rail road could also be constructed so as to connect the head of steamboat navigation in the county of Stokes, N. C. with the Charleston and Cincinnati rail road, passing through a highly favorable and fertile country, on the Yadkin and Catawba rivers.

Staunton River.

A communication is effected between this river and the Dan by the thoroughfare at the head of Nelson's Island. A similar mode of improvement is also recommended. The fall from the Dan river at the head of Nelson's Island to the town of Brookneal is 84 $\frac{85}{100}$ feet, and the distance is 48 miles 4193 feet; the average width does not exceed 150 yards.

The whole distance of the contemplated improvement extends 171 miles 2636 feet, and the fall 354 $\frac{68}{100}$ feet, averaging 2 $\frac{06}{100}$ to the mile, furnishing a very favorable result in support of the mode of improvement recommended.

The whole estimated cost is $650,169 20, averaging 3791 dollars per mile, or 1833 dollars per foot fall.

[The report next exhibits different "General Estimates" or statements in detail of the various particular works required, and the estimated cost of the improvements proposed, to furnish slack water steamboat navigation, (4 feet deep at all seasons,) by locks, dams, and short canals, from Rocklanding, at the head of the great falls of Roanoke, as high as Danville, on the Dan, and Brookneal, on the Staunton. It is unnecessary to insert here these several estimates in full. The following abstract from them, which concludes the report, will suffice for the general reader. Ed. F. R.]

Abstract.

	Length of ponds.		Length of canals.		Total lengths.		Dams.		Locks.		Cost of Works.
	Miles	feet	Miles	feet	Miles	feet	No.	Height.	No.	Height.	
Roanoke River, -	49	3857	10	1209	59	5066	15	86.03	25	158.46	$347,799 29
Dan River, - -	61	2034	1	1903	62	2937	17	107.34	18	117.37	185,308 00
Staunton River, -	48	3351	0	842	48	4193	14	91.26	13	78.85	137,062 00
	159	3962	11	3954	171	2636	46	28.463	56	35.468	$670,169 29
Value of work done, and materials available, - - -											20,000
											$650,169 29

Respectfully submitted,

John Couty.

Richmond, January 9, 1838.

SKETCH OF THE PROCEEDINGS OF THE LATE AGRICULTURAL CONVENTION OF N. YORK.

The following commmunication will be read with interest by every subscriber to the Register, who is properly impressed with the importance of the combined action of the agriculturists of Virginia, for the purpose of protecting their own interests, and, by that means, also the best interests of the commonwealth. At the same time, every such reader will feel both sorrow and shame, in being compelled to believe that no such public-spirited views and action are to be hoped for in Virginia, from the people, and still less from the legislature. In the latter body, any subject, either frivolous, or useless, or hurtful, may be introduced, and discussed at length, at the expense of thousands to the treasury, in mere consumption of time; petitions for money, for the private gain of individuals and corporations, unsupported either by justice or policy, are granted for hundreds of thousands. But the urgent wants of the great agricultural interest are not thought of; and if any such claims are attempted to be brought forward, they are promptly rejected, after the shortest possible hearing, with scorn, ridicule and contempt. If the legislature of Virginia would appropriate judiciously, for the promotion of agricultural improvement and instruction, but the tenth part of the average annual expense of discussions and grants, either totally useless, or decidedly hurtful, the commonwealth would rapidly regain her formerly prosperous and dignified condition.

Ed. Far. Reg.

To the Editor of the Farmers' Register.

Kinderhook, February, 16, 1838.

Last year I gave you a short abstract of the proceedings of our state Agricultural Convention and Society at Albany. If you recollect, we then passed a resolution to hold a similar meeting at the same place, in February, 1838. That meeting has been held according to appointment; and in the absence of the the printed reports of it, which will be given to the public in a few days, permit me to give you a short sketch of our proceedings. The sketch will necessarily be imperfect, as I have no minutes before me, in aid of my memory; neither can I make a discrimination between the acts of the society and convention, for as the object was one, their proceeding would, consequently, run into each other.

The convention organized in the Assembly Chamber on Thursday, the first of February. I think there were about one hundred and fifty members in attendance. In the number of delegates were several members of both senate and assembly, having been chosen by their respective counties, to represent them in that body. A temporary chairman was chosen until time was given us to make out a regular list of officers. J. R. Lawrence of Onondaga, was elected president, assisted by nine vice-presidents and four secretaries. After the preliminary business was disposed of,

the first subject that elicited discussion was a resolution offered "that elementary books, which treat of agriculture, should be introduced into our common schools." An interesting debate took place on this motion; and in a short time, gave conclusive indications of the views of the convention. The speeches in the affirmative were numerous; with but two dissentients. Upon taking a vote, however, there was only one who gave a negative.

The next subjects in order were the reports of the several committees appointed last year, with instruction to report at this meeting. Having given time to collect facts, the reports were consequently more valuable and interesting. Judge Buel reported all the facts he had been enabled to gather in relation to the history and habits of the grain worm *(vibrio tritici)*; but, as nothing satisfactorily had yet been ascertained, that will tend to prevent its ravages upon our wheat, it was referred back to the same committee, to glean further facts, and report to a subsequent convention. You are aware of the important bearing this subject must have upon our prosperity and agriculture. In truth, if we cannot get rid of the evil or obviate the effects, and if it continues to be spread, as it has done for the last two years, it will be but a short time before it will extend into the western portions of the state, where wheat is the great staple, and where it will most effectually prevent the raising of that article. This would be almost a death blow to the prosperity of the state, as we cannot dispense with wheat as an article of food, nor afford to lose it as a source of revenue. The region in which I live, was a few years ago a wheat-growing country; but since this insect has made its appearance, the destruction of the crop has been so great, that we are discouraged from sowing it at all. In 1836, I sowed sixteen bushels of winter wheat, on prime land; my crop in 1837 when thrashed, amounted to two and half bushels. My neighbors have fared little or no better; and from selling every year a large surplus, most of us are obliged to buy it for bread. The ravages of the fly probably now extend to about one hundred miles square, making Albany the centre—certainly not less than that; but it seems to spread each succeeding year, rather farther in the direction towards our wheat region in the west, than any other. I have been led into this digression to show how important it is for the farmers in this region to discover an antidote for so great and spreading an evil.

The next report was in the nature of "an inquiry whether in the distribution of public moneys in aid of agriculture, a better mode could be devised than that of giving it to the county agricultural societies, to be awarded in premiums." Mr. Viele of Rensselaer, in behalf of the committee, took a very interesting view of the subject, and concluded by moving three resolutions: First, that from all the information we have had, and the experience gained by the former establishment of agricultural societies, we cannot do better than to re-establish them, avoiding the defects of the former system; second, that a Central Board of Agriculture ought to be established at the seat of government, to correspond with the county societies—collect rare and valuable seeds and disseminate them—examine new farm implements—form a mineralogical, geological, and agricultural cabinet—and publish, as occasion may require, such essays and communications as will tend to the advancement of agriculture. Third, that the legislature furnish funds for the endowment of an agricultural school. The two first resolutions were received with acclamation, passed upon without debate, and without a dissenting voice; that asking for the endowment of an agricultural school led to a good deal of discussion. The committee did not press it, and at the time of offering it, told the convention so; but so many warm friends came forward so promptly to advocate its adoption, and so few to oppose it, that, after an animated discussion, it passed with but one dissentient voice.

A communication was next read by Judge Buel on the necessity of the legislature providing funds in aid of agricultural improvement. I cannot now enter into a detail of the many subjects embraced in this communication. It was principally a collection of statistical facts, and the reasoning founded upon them, to show how much was yet wanting to place our husbandry upon the ground we ought to occupy, as commensurate with our position, our resources, the fertility of our soil, and the industry and intelligence of our citizens.

Mr. Walch reported upon the necessity and importance of increased attention to horticulture and the household arts; Gen. North on neat stock; Mr. Randall on sheep; and Mr. Barnett on swine. Some of these reports were elaborate essays on the subjects presented, and were as interesting to the convention, as they were creditable to the gentlemen who prepared them.

Resolutions upon various topics within the scope of our duties, were severally presented; many of them elicited debate and gave rise to interesting discussions; generally they were adopted, and as these reports are to come in at our next meeting in February, 1839, they will give interest to the proceedings at that time. Suffice it to say that we have cut out business enough for a week's session hereafter. You see by this short abstract that our proceedings have lost none of their interest; and, for the last year, agriculture, none of its friends. The resolutions last referred to, you will have the opportunity of seeing in our printed accounts, and you can form your own judgment, how far their adoption will lead to beneficial results. The signs of the times are auspicious to the attainment of our object. Several of the prominent members both of the senate and assembly took an active part in our discussions. Political considerations gave way to a higher sense of duty; and all stood on common ground, and were desirous to promote a common object. At no previous time have our legislators come forward manfully and satisfactorily, and given assurances, as far as their declarations and speeches in the convention are evidence of it, of their determination to act as will best promote the great interests of agriculture. I think there is hardly a doubt, but, at this meeting of our legislature, we will carry out the plans suggested in the report of the committee on agriculture of the assembly, a copy of which I send you. No doubt there will be some alterations in the details, while passing through the house, to make them more efficient, but as the report is, in a measure, based upon acts of the convention, and that convention composed of persons as competent to advise upon the wants of agriculture, as could, by any possibility, be selected in this state, there is

every reason to believe they will at least have a fair hearing before the representatives of the people. I remain your friend,

J. P. BEEKMAN.

REPORT OF THE COMMITTEE ON AGRICULTURE, [OF THE LEGISLATURE OF NEW YORK,] ON THE MEMORIAL OF THE STATE AGRICULTURAL CONVENTION, ASSEMBLED IN ALBANY ON THE FIRST DAY OF FEBRUARY, 1838.

Mr. L. F. Allen, from the Committee on Agriculture, to whom was referred the memorial of the State Agricultural Convention assembled in Albany on the first day of February, 1838,

REPORTS:

Although the duties of the Committee on Agriculture have oftentimes been considered rather nominal than active, yet your committee, on a review of past years, and a careful examination of the present condition of the state, have come to the conclusion, that a serious responsibility, at this time, rests upon them; that they are charged with some of the highest duties which devolve upon the legislature of a state; the guardianship of that primary branch of industry which is the source of our prosperity and greatness, and our sure dependence in times of public peril and misfortune. Politicians may speculate upon the influence which free institutions, or a partizan administration, may have upon the prosperity of a country; commercial men may extol the advantages of an extended foreign commerce; manufacturers may claim pre-eminence in conferring independence upon their country; and literature may arrogate the exclusive credit of rendering a community enlightened and polished; yet, after all, agriculture constitutes the broad base upon which the whole superstructure of society depends for support. If that languishes, either for want of the protection and patronage of the constituted authorities, or from the inattention and lack of intelligence in its rural population, the government becomes embarrassed, commerce crippled, and manufactures paralyzed. A maritime war may sweep our commerce from the ocean; our manufactures may sink for want of a market for their fabrics—as they have done; but agriculture never disappoints our hopes, while we continue to enjoy the blessings of a kind Providence, whose favor it is alike our duty and our interest to propitiate, by prudent foresight and dutiful submission to all his requirements. The soil, under judicious management, never withholds the tribute of reward to those who humbly devote themselves to its culture, and place upon it their only sure reliance. Upon this, then, we ought to bestow our special attention, our protecting care. These truths have been amply illustrated and established in the experience of the two last years. Your committee are persuaded that the condition of the agriculture of any country affords a safe criterion whereby to judge, not only of its general prosperity, but of the social and moral condition of its population.

The recollections of the age will serve to show, that the relative condition of our agriculture, and that of many of the countries of Europe, has undergone a remarkable change within the last forty years. While the latter has been increasing, ours has been diminishing in its products. About the commencement of the present century, the exportation of bread stuffs and other provisions, from the northern and middle States, amounted, annually, to twelve or fourteen millions of dollars, principally to the continent of Europe. In the two last years, instead of exporting provisions to Europe as formerly, we have imported from thence bread stuffs to the amount of seven or eight millions of dollars. These facts conclusively show, that the agricultural products of Europe have greatly increased, while ours have been diminishing, in proportion to our population, notwithstanding the vast accession of fertile virgin soil which has been constantly enlarging our borders. Whence this great change, but from a neglect, on our part, to nurture this great branch of national industry; and a diligent and constant endeavor, on the part of the governments and people of Europe to improve it? We have the most ample evidence that the efforts of our cotemporaries on the old continent have been crowned with abundant success. France and Germany have made great advances in agricultural improvement. The once barren sands of Brandenburgh, and the no less unproductive heaths of Prussia, are now covered, through the active efforts of the Prussian government, with plentiful harvests of the finest grain in the world. The soil of England has been made to more than double its products within the last sixty years; and Scotland has quadrupled her agricultural products since the termination of our revolutionary war.

While such has been the recent progress of agricultural improvement in Europe, what has been our progress in husbandry? Has it not been retrograde? Have not our cultivated lands been generally deteriorating, under an exhausting system of husbandry? and have not large tracts, once fertile, on the Atlantic border of our country, been absolutely abandoned, as unprofitable for culture, on account of the sterility produced by our bad husbandry?

Under the view of the subject which these facts present, the committee feel it their duty to press upon the consideration of the Legislature, who are delegated to take care of the public weal, an investigation into the causes which have led to this great, this alarming change, in the relative condition of the two continents; and to urge them to adopt prompt and efficient means, not to repress the European spirit, which has done so much good to the human family, but to transfuse a portion of that spirit into our own population, and to raise the character of our agriculture, as we can and ought to do, to the level of that of any country on the globe. Fortunately, we are not left in doubt as to the prominent means of effecting this desirable object. Other governments have made the experiment for us; have set us the example, and in a measure demonstrated the certainty of success. Those governments have patronized and aided this noble art, by protection and rewards; by instruction, in the primary schools, in the elementary principles of husbandry; by national boards of agriculture; by agricultural surveys, and by schools of scientific and practical instruction in the diseases and management of domestic animals, and in the business of agriculture generally.

The state of Massachusetts was among the first to encourage the establishment of agricultural societies, and to dispense to them the public bounty. Her continuing to persevere in this policy to the present time, by a renewal of the law, making an annual and liberal appropriation to this object, is at once an evidence that she has found such expenditure salutary, and in perfect unison with the feelings and wishes of her enlightened population.

The State of Maine has also given an example of great liberality and wisdom, in recent efforts to improve her agriculture. The bounty which she this year pays to her citizens, to encourage the culture of wheat alone, will draw from the treasury a greater sum, than all the expenditures, which the "empire state" has made *directly* in aid of *her* agriculture, put together.

Several of the states have likewise, with a view to encourage a useful and lucrative branch of home industry, offered liberal bounties for the cultivation of the mulberry, and the production of silk. A slight reference to the proceedings of the current legislatures of several of our sister states, at this moment, may show the position which our own proud state should assume on this important subject.

A bill is now before the legislature of Massachu-

setts for giving a bounty to her citizens for the production of wheat.

A bill is in discussion in the legislature of Kentucky to establish a board of agriculture, and state and county societies.

A bill is before the legislature of Maryland, to establish and patronize agricultural schools, &c.

The same is under consideration in the young and enterprising state of Michigan, for the establishment of state and county agricultural societies, with appropriations from the state funds for their support.

And even Wisconsin, that wild, though fertile and rapidly increasing territory of the great west, is engaged in the same laudable work.

Nor do we lack a useful lesson of instruction at home. The law passed in 1819, "to improve the agriculture of this state," did do what its title purported; it *did improve* the agriculture of this state. It improved our farm stock, our farm implements, our farm crops, and modes of culture; and it gave a new impulse to useful enterprise and improvement. And although the manner of its execution was in many cases faulty, as all new experiments are liable to be in the outset; yet it effected a great public good. That law involved a public expenditure of twenty-five or thirty thousand dollars, and no like sum, your committee are induced to believe, has been expended from the state treasury with greater public advantage. Its benefits are now palpable, and are acknowledged by all intelligent men. Indeed, it has been stated, upon no slight grounds, that the expenditure has been more than thrice returned to the treasury, in the form of canal tolls upon the extra products of the soil, which it virtually created

There is another subject to which the committee deem it proper to call the attention of the legislature. The insect denominated the grain worm, has, for several years, been greatly destructive to the wheat crop in the northern and north-eastern counties of the state. It is progressing south and west, and threatens to cut off, or at least seriously to diminish, the great staple of our soil, and the source of much of our wealth. If the attention of naturalists, and the critical observation of practical farmers, were directed to the character and habits of this insect, by offers of a liberal bounty for the discovery of an efficient preventive of its depredations, it is believed that great public benefit might result from the measure, while it seems certain that no injury could ensue from it.

Your committee believe, that in all the arts of productive labor, and particularly in agriculture, it is highly important, to the attainment of excellence, to commence instruction in the primary schools. And as we now have published, in our state, agricultural journals of as high and useful character as are published in the world, and at a price less than one-fourth the cost of an equal quantity of matter in a book form, they consider their introduction into our common schools as occasional class-books for our youth, a cheap and efficient means of improving both the mind and the soil.

From the best consideration which the committee have been able to give to the important matters which come within the purview of their duties, they have come to the unanimous conclusion, that the time has arrived, when the public interest, and the popular will, alike require the exercise of legislative wisdom, and legislative bounty, to improve the condition of our agriculture; the business, as has been already remarked, which gives employment to the mass of our population, and which is the main source of prosperity to all the other classes of society. The committee, therefore, recommend that, with a view of promoting the desired improvement, a law be enacted to organize a state board of agriculture, and to establish agricultural societies in the several counties of this state; and that an annual expenditure of 25,000 dollars be authorized, for five years, with suitable provisions and under proper restrictions. to improve the agriculture of this state. The committee have prepared a bill in accordance with their views upon this subject, and have directed their chairman to ask leave to present the same.

AN ACT

TO IMPROVE THE AGRICULTURE OF THIS STATE.

The people of the state of New York, represented in Senate and Assembly, do enact as follows:

§ 1. That the sum of twenty thousand dollars per annum shall be, and hereby is appropriated, for the term of five years, for the promotion of agriculture and household manufactures in the several counties of this state, in the manner following, to wit: To the county of Albany five hundred and twenty-one dollars; to the county of Allegany, three hundred and forty-eight dollars; to the county of Broome, one hundred and seventy-four dollars; to the county of Cattaraugus, three hundred and forty-eight dollars; to the county of Cayuga, five hundred and twenty-one dollars; to the county of Chautauque, five hundred and twenty-one dollars; to the county of Chemung, on hundred and seventy-four dollars; to the county of Chenango, five hundred and twenty-one dollars; to the county of Clintin, one hundred and seventy-four dollars; to the county of Columbia, five hundred and twenty-one dollars; to the county of Cortland, three hundred and forty eight dollars; to the county of Delaware, three hundred and forty-eight dollars; to the county of Dutchess, five hundred and twenty-one dollars; to the county of Erie, five hundred and twenty-one dollars; to the county of Essex, one hundred and seventy-four dollars; to the county of Franklin, one hundred and seventy-four dollars; to the county of Genesee, six hundred and ninety-five dollars; to the county of Greene, three hundred and forty-eight dollars; to the county of Herkimer, three hundred and forty-eight dollars; to the county of Jefferson, five hundred and twenty-one dollars; to the county of Kings, three hundred and forty-eight dollars; to the county of Lewis, one hundred and seventy-four dollars; to the county of Livingston, three hundred and forty-eight dollars; to the county of Madison, five hundred and twenty-one dollars, to the county of Monroe, five hundred and twenty-one dollars; to the county of Montgomery, five hundred and twenty-one dollars; to the county of Niagara, three hundred and forty-eight dollars; to the county of Oneida, six hundred and ninety-five dollars; to the county of Onondaga, six hundred and ninety-five dollars; to the to the county of Ontario, five hundred and twenty-one dollars; to the county of Orange, five hundred and twenty-one dollars; to the county of Orleans, one hundred and seventy-four dollars; to the county of Oswego, three hundred and forty-eight dollars; to the county of Otsego, five hundred and twenty-one dollars; to the county of Putnam, one hundred and seventy-four dollars; to the county of Queens, one hundred and seventy-four dollars; to the county of Rensselaer, five hundred and twenty-one dollars; to the county of Richmond, one hundred and seventy-four dollars; to the county of Rockland, one hundred and seventy-four dollars; to the county of St. Lawrence, three hundred and forty-eight dollars; to the county of Saratoga, three hundred and forty eight dollars; to the county of Schenectady, one hundred and seventy-four dollars; to the county of Schoharie, three hundred and forty-eight dollars; to the county of Seneca, one hundred and seventy four dollars; to the county of Steuben, five hundred and twenty-one dollars; to the county of Suffolk, three hundred and forty-eight dollars; to the county of Sullivan, one hundred seventy-four dollars; to the county of Tioga, one hundred and seventy-four dollars; to the county of Tompkins, three hundred and forty-eight dollars; to the county of Ulster, three hundred and fifty dollars; to the county of Warren, one hundred and seventy-five dollars; to the county of Washington, three hundred and fifty dollars; to the

county of Wayne, three hundred and fifty dollars; to the county of Westchester, three hundred and fifty dollars; to the county of Yates, one hundred and seventy-four dollars.

§ 2. That when an agricultural society shall be formed in any county, or in two contiguous counties, and the members thereof shall annually procure, or raise by voluntary subscription, any sum of money, the president and treasurer shall make and subscribe an affidavit of the facts of the formation of such society, and of their having raised a certain sum, specifying the amount thereof, which affidavit shall be filed with the comptroller of this state, who shall draw his warrant on the treasurer for a sum equal to double the amount of such voluntary subscription, not, however exceeding the amount to which such county or counties would be entitled, according to the apportionment aforesaid.

§ 3. That the several agricultural societies which shall be formed in this state, during the continuance of this act, shall annually elect such and so many officers as they shall deem proper, all of whom shall be actually engaged in carrying on the business of farming; none of whom, however, shall receive any emolument from his office; and it shall be the duty of such officers annually to regulate and award premiums on such articles, productions, and improvements, as they may deem best calculated to promote the agricultural and household manufacturing interest of this state; having especial reference to the nett profits which accrue, or are likely to accrue, from the mode of raising the crop or stock, or the fabrication of the article thus offered, with the intention that the reward shall be given for the most economical or profitable mode of competition; provided always, that no individual shall receive more than two premiums at any anniversary meeting, nor more than one first and one second *premium* at any subsequent time upon the same animal, and that no person shall receive any premium from an awarding committee of which he is a member thereof; and provided further, that before any premium shall be delivered, the person claiming the same, or to whom the same may be awarded, shall deliver in writing to the president of the society, as accurate a description of the process in preparing the soil, including the quantity and quality of manure applied, and in raising the crop, or feeding the animal, as may be; and also of the expense and product of the crop, or of the increase in value of the animal, with the view of showing accurately the profit of cultivating the crop, or of feeding or fattening the animal.

§ 4. That if an agricultural society shall not be organized in any county, or shall neglect to raise by voluntary subscription, a sum which shall entitle them to the apportionment made to said county by this act, the board of supervisors of said county are hereby empowered, at their pleasure, during the continuance of this act, to raise annually, in the manner the contingent charges of said county are required to be raised, a sum equal to one half the amount hereby appropriated to said county. And whenever the president of said board of supervisors shall certify to the comptroller that such board of supervisors have resolved to raise such sum, it shall be the duty of the comptroller to draw his warrant on the treasurer of the state, in favor of the treasurer of such county, for the sum appropriated for said county by the first section of this act.

§ 5. That it shall be the duty of the supervisors of every such county, to cause all the money so raised and received for agricultural improvement, to be paid and expended at an annual agricultural exhibition, to be held in such county, at such time as they shall appoint, in such manner as shall, in their judgment, best promote the legitimate object of this act, and subject to all the provisions contained in the third section thereof.

§ 6. That the several presidents of the said societies, and of the boards of supervisors, who shall receive or expend any of the moueys hereby appropriated, shall annually, in the month December, transmit all such reports or returns as they are required to demand and and receive, to the secretary of the state board of agriculture, hereafter named and organized, together with an abstract of their proceedings, exhibiting a detailed account of the expenditure of all the moneys which shall come into their hands under this act, and stating to whom and for what purpose paid, with the vouchers therefor.

§ 7. There shall be organized a State Board of Agriculture to consist of five members, who shall hold their offices for five years from the second Tuesday of February, one thousand eight hundred and thirty-eight, and shall receive, while necessarily employed in the duties enjoined by this act, the same compensation as members of the legislatare. They may choose such officers as they may deem necessary, and shall hold quarter-yearly meetings in the city of Albany on the first Tuesdays in February, May, August and November; and may also meet at such other times as may be found expedient to fulfil the duties hereafter enjoined upon them.

§ 8. There shall be assigned for the meetings of the State Board of Agriculture, and as a museum for models, geological specimens, and agricultural productions, a suitable apartment in the state buildings now erecting; which room and museum shall be kept in order by the secretary, or by some person to be appointed by the board, and shall at all reasonable hours be open and accessible to the public without charge.

§ 9. It shall be tbe duty of the State Board of Agriculture to examine all reports and returns made by the presidents of the county agricultural societies, and boards of agriculture; to select, for publication, such of them, and such other essays as they may judge advisable; and shall annually publish a volume to be distributed in the several counties of this state, by the county agricultural societies, or by the boards of supervisors thereof. And they shall examine, when in session, and determine by practical experiment on the merits of all new farm implements or machinery offered for their examination, and may award discretionary premiums, upon such as may be found truly meritorious and deserving of public patronage, provided the whole amount expended in any one year shall not exceed the sum of one thousand dollars for that purpose; and provided further, that no such premium shall be delivered to the person claiming the same, until he has deposited with the board a model of his implement, machine ,or improvement.

§ 10. There shall be deposited in the room assigned to the board, a complete set of mineralogical and geological specimens, properly arranged and labelled, from the collections now being made by the geological corps in the public employ; specimens of choice or rare agricultural productions, models of implements, drawings of choice animals, books, and other articles which may be presented to the museum, a registry of all which shall be made by the secretary, and open to the public inspection.

§ 11. The said State Board of Agriculture shall report annnally to the legislature, in the month of January, a statement of their expenditures and of their proceedings during the previous year; and also all matters that they may deem calculated to promote the improvement of agriculture and of household industry.

§ 12. A reward of five hundred dollars shall be and is hereby offered to any person who shall discover and will communicate to the State Board of Agriculture, for the public benefit, a sure and efficient preventive of the depredations of the insect denominated the grain worm; the efficacy of the said preventive to be tested by the said board during at least one year, and satisfactorily confirmed, before the said award shall be given; and if the discovery shall prove but a partial remedy of the evil, it is made discretionary with the said board, or a majority of them, to award such part of the sum

hereby appropriated, as its importance may seem to justify.

§ 13. That the treasurer of the state shall annually pay on the warrant of the comptroller to the said State Board of Agriculture, the sum of five thousand dollars, to enable them to pay the aforesaid premiums; to purchase and distribute such useful seeds as they may deem proper; to publish an annual volume; and to defray such other necessary expenses to promote the object of this act, as are not otherwise provided for; and the said board shall annually account with the comptroller for the expenditure of this money.

§ 14. That the presidents of the several county societies, or delegates to be chosen by them annually for the purpose, shall be ex-officio members of the New York State Agricultural Society.

§ 15. The Board of Agriculture, constituted as aforesaid, shall have the ahthority in their discretion, to award premiums for the production of extraordinary and valuable crops o. grain; beet root, and sugar manufactured from the same; mulberry orchards, and silk manufactured therefrom; or any other agricultural or horticultnral productions or household manufactures, which in their view shall by such encouragement add to the productive wealth of the country; not exceeding, however, in amount, the sum of five thousand dollars hereby placed in their hands.

§ 16. The collectors of taxes in the several towns in the state of New York are hereby required, while collecting the same, to ascertain, as near as may be in their power, the number of bushels of grain of different kinds, of esculent roots, and of hay produced during the current year in their respective towns, and the number of horses, cattle, sheep and swine then in existence, and report such amount to the Board of Agriculture, in the city of Albany, on or before the first day of January in each and every year hereafter. Such report to be directed to "The State Board of Agriculture, Albany."

§ 17, The sum of twenty-five thousand dollars appropriated by this act shall be taken from the income of the surplus fund deposited with the state of New-York by the United States.

§ 18. The first Board of Agriculture shall consist of who are hereby appointed for the term of five years aforesaid, and all vacancies that may occur in said board shall be filled by joint ballot of both houses of the legislature at their annual session, to be held by the incumbents for the same period of time.

§ 19. The State Board of Agriculture shall procure of the agricultural periodicals entitled 'The Cultivator,' and 'The Monthly Genesee Farmer,' as many copies of each, commencing with the current volumes, as there are common school districts in the state, and shall cause as many copies of each to be addressed to the school commissioners of each town as there shall be such school districts in the same; and it shall be the duty of school commissioners to cause the said papers to be promptly distributed, one copy of each to the several schools, and of the trustees of said school districts to have the same properly taken care of, and to be used as occasional class books in said schools.

§ 20. The comptroller shall, on the requisition of the said Board of Agriculture, draw his warrant on the treasury of the state for the payment to each of the proprietors of the said agricultural papers for the number of copies so delivered, estimating each of them at fifty cents per copy; such payment to be made from the common school fund.

For the Farmers' Register.

COMMERCIAL REPORT.

We cannot felicitate our readers on a prosperous state of commercial affairs. The difficulties which have long prevailed in internal exchanges and money matters generally, are not alleviated. The country is, in fact, without a currency. There is, to be sure, a local and very diminished circulation of the notes of state banks, which is circumscribed within the limits of each state; but even this local currency has been so much contracted since the suspension of specie payments, as to be inadequate to the trade of the country; and proof of the actual deficiency of a circulating medium, may be found in the present state of foreign exchanges. Bills on London can be purchased at so low a rate, ($4.70 per £ sterling,) as to leave a profit on the importation of specie, although the very bank notes with which the bills are purchased, are 2 to 4 per cent *below* the value of specie. It is said that some of the northern banks are remitting bills of exchange, for the purpose of filling their vaults by importation of the precious metals; and this course will facilitate the resumption of specie payments, if the general government will remove the obstacles which its measures have created.

The space in our circulation which silver formerly occupied, is now filled with an illegal emission of private bills of various small denominations, down to "six cents," issued by whoever chooses to *take* the responsibility; and the necessities of the community compel them to aid in this violation of the law, by giving free circulation to these "shin-plasters," because there is no other medium. The legislature may continue to enact penal statutes, but will find that "necessity has no law." It is by a *repeal* of unwise statutes, and not by the enactment of others, that the evil is to be remedied. So long as the general government requires her debtors to pay in specie, even when unable to pay her creditors in the same coin, there is little hope of our affairs being restored to order.

Exchanges between New York and other places, are at the following rates of discount, viz:—Boston, Philadelphia, Baltimore and Virginia, 2½ per cent; North and South Carolina, and Georgia, 3½; New Orleans, 4½; Mobile, 10.

Bank notes of the same states (as being of more hazardous transmission than bills of exchange,) are at a still greater discount. Those of Tennessee at 15, and of Mississippi, at 20 per cent.; an *equalization* of the currency which has not existed since 1816!

The staple products of the country have declined since the commencement of the year. Cotton may now be quoted (in Petersburg,) 8½ to 10 cents, dull, which is nearly as high as the New York market for similar qualities. Flour, $7¼ to $7½. Tobacco, $3 to $7½.

The receipts and exports of cotton since the 1st of January, have been large beyond precedent. The following is a comparative statement in round numbers:

Receipts.	*Jan'y* 1, 1838.	*Febr'y* 20, 1838
N. Orleans,	169,000 bales	360,000
Mobile,	60,200	186,000
Florida,	10,000	37,000
Georgia,	97,800	170,000
S. Carolina,	100,000	167,000
N. Carolina,	3,700	10,000
Virginia,	9,300	20.000
	450,000	950,000
Same dates in 1837,	455,000	735,000

Exports.	*Jan'y* 1, 1838.	*Febr'y* 20, 1838.
To G. Britain,	153,000 bales	425,000
France,	62,000	125,000
Other ports,	10,000	25,000
	225,000	575,000
Same dates in 1837,	276,000	500,000

An intelligent writer in the Philadelphia Commercial List, whose estimate of the grain crops we quoted last year, has pursued his investigations on the subject, and arrives at the following conclusion, as respects the crop of wheat, from the premises stated.

"It has been ascertained with tolerable accuracy, that the quantity of flour introduced into the New England States and consumed there, is about 800,000 bbls., and that the wheat grown in those States would afford for consumption about 200,000 bbls. more, giving five millions bushels for a population of 1,955,000, according to the census of 1830; being about 2-11ths of the *white* population of the U. States at that time, which was 10,857,000. The same ratio of consumption would require 27,500,000 bushels.

Exported in wheat and flour	9,500,000
Reserved for seed &c. about	3,000,000
would make the aggregate crop	40,000,000 bushels.

"This conclusion is founded on the assumption, that the wheat flour used in New England, affords a fair criterion of its use throughout the United States."

"In the interior of New England the consumption of rye flour is much more general than in the sea-port towns. In New Jersey one half the bread used is rye; and the best rye bread, perhaps in the world, is made in that state. In the German districts of Pennsylvania, rye and buck-wheat are extensively consumed. As we proceed south, we find Indian corn in various forms, on almost every table, and such is also the case in the south-western states. In the Carolinas and Georgia, rice is extensively substituted for wheat bread."

"The slaves consume scarcely any wheat. The bread they use, is made of Indian corn meal, which they prefer: no art is required in the preparation, and it makes a wholesome and nutritious bread.

"Again, it appears that the quantity of flour included in the inspection returns of 1831, was 3,117,125 barrels. As there was an unusual demand for export to England that year, which swelled the aggregate export to 1,805,205 barrels, we believe that more than a fair proportion of one crop was brought to market and included in the inspection, but shall not notice this difference. Of the wheat grown in all the great wheat districts of the middle and western states, we believe full 3-5ths of what remains, after deducting seed, is brought to market, when prices are favorable. From the Eastern and Western Shores of Maryland, and from Virginia, where slaves are employed in its cultivation, very little beyond the seed is kept back. The small quantities raised in the eastern states as well as south of Virginia, are consumed at home, except some little imported from North Carolina. Allowing, however, that one half of the whole quantity raised in the wheat districts is brought to market on the sea-board, it would make 6,234,250 barrels, equal to 31,171,250 bushels.

Add for seed, - -	3,128,750
And for wheat raised in New England and other places that do not send to market, - -	5,700,000
And we again make the crop	40,000,000 bushels."

"In England, great attention is paid to ascertaining the growth and consumption of wheat and other grain, and it is estimated that the consumption of wheat in *Great Britain*, is 12,000,000 quarters, or 96,000,000 bushels, by a population taken in round numbers, at sixteen million, making an average of six bushels to each head. But in Great Britain, the use of Indian corn is unknown; rye is very moderately used for culinary purposes, and rice only as a luxury. The proportion of wheat consumed, must be much greater than in this country, we would say one-half, calling it one-third greater; we have, by this analogy, four bushels per head for a population of 10,857,000, say 43,428,000 bushels; and adding for seed and export a total of about fifty-seven million bushels for one crop. If taken at the proportion of one-half, about forty-five million bushels."

"Such discussions we hope will bring the subject to the attention of Congress; and in the law which must ere long be passed to provide for taking the census of 1840, we hope to see provision made for taking such an account of the agricultural and manufacturing pursuits of the country, as will form a new era in our economical history."

"The crop of Indian corn has been stated at one hundred million bushels; but we believe this estimate is too low, and that it should be stated at one hundred and twenty. Rye, estimated at twenty million bushels, is probably too high for the present state of cultivation; and barley at one and a quarter million, is too low. But having no data by which to make satisfactory estimates, we must leave the further investigation to be made by such a law as is above referred to; the only way in which it can be done satisfactorily."

Inspection of Flour.

	1820	1830	1835	1836	1837
Philadelphia,	400.814	473.876	361.276	337.917	214.339
New York,	267.365	870 585	1.154.613	1.133.554	*904.488
Baltimore,	465.657	597.804	527.266	400.230	399.064
Alexandria,	233.505	156.849	66.438	36 543	38.604
Georgetown,	107.372	139.713	110.840	108.513	61.618
Fredericksburg,	81.478	96.060	53.222	26 810	†20.000
Falmouth,	†30.000	46.406	48.000	25.000	†17.000
Richmond,	152.924	251.024	204.151	129.131	140.984
Petersburg,	56.593	72 000	44.937	26.877	36.508
New Orleans,	†100.000	‡133.700	285.705	287.191	264.356
	1.895.708	2.838.017	2.856.448	2.511.766	2.096.961
Add for N. York from Jan. 9 to May					100.000
					§2 196.961

*From May 9 to Jan.
†Quantity assumed—no returns obtained.
‡N. Orleans in 1831—360.850 bbls.
§About three millions bushels foreign wheat was ground in 1837.
It should be observed that in N. York a large quantity of southern flour is *re-inspected.*

March 1, 1838. X.

ERRATUM.

In the article headed "Various soils of Alabama," in No. 9. page 562, first column, second line from bottom, for "*feet*" read "*inches.*"